34.

Science Library

FEBRUARY 1941

WORLD PETROLEUM

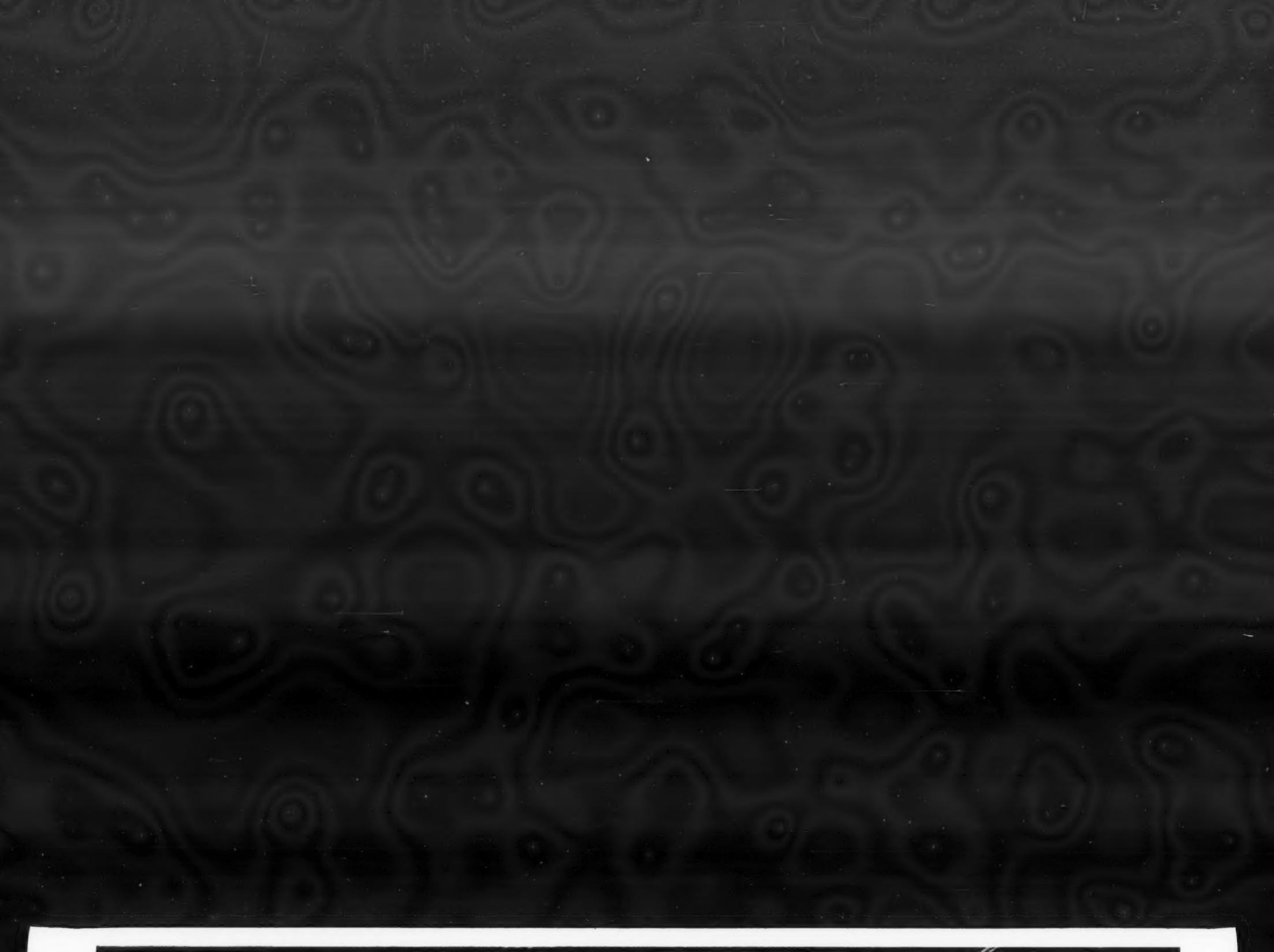
FEB 28 1941

NEW YORK AND LONDON

Standard Oil Development Co.

Meisel Photo

MANUFACTURING POWER
for land, sea and air
Modern gasoline plants like this are destined to play no small part in America's program to insure a continuance of the democratic way of life
fabricated by
Wyatt's
WYATT METAL & BOILER WORKS · Houston . . . Dallas, Texas



WORLD PETROLEUM

Founded by Russell Palmer

E. W. Mayo
Editor

T. Orchard Lisle
Executive Editor

E. W. Mayo, Jr.
Managing Editor

S. J. Gallay
Advertising Manager

VOLUME 12 | FEBRUARY, 1941 | NUMBER 2

WORLD PETROLEUM: Incorporating Petroleum Equipment Exporter

CONTENTS

World Production Up 3.33% 19

World Crude Production Tables . . 20

Broadening Field of Compact . . 22

Pipeline Obstruction 23

Hawkins Field 24

U. S. Exports Drop Heavily . . 26

Role of Residual Fuel Oil . . . 30

Standard Development's Research . 36

Foreign Oil Legion 49

Abstracts 52

CORRESPONDENCE

Address all correspondence regarding editorial, advertising, subscription and business matters to the Home Office; 95 River Street, Hoboken, N. J. Telephone Rector 2-2043 or Hoboken 3-2480.

London office; Brettenham House, Lancaster Place, W.C.2.

Los Angeles office; 412 West 6th Street

SUBSCRIPTIONS

Annual subscription to World Petroleum is offered at the flat rate of five dollars (U. S.) postpaid to any country in the International Postal Union.

For the convenience of subscribers the publisher will accept payment in any of the following currencies at the fixed rate shown below:

Argentina	4.17 paper pesos
Brazil	58 paper milreis
Canada	5.00 dollars
Colombia	5.00 pesos
France	190 francs
Germany	13 reichsmark
Great Britain	1 guinea
Netherlands	10 guilders
India	15 rupee
Iran	1 guinea
Iraq	1 guinea
Italy	95 lire
Japan	20 yen
Mexico	14 pesos
Peru	6 sol
Poland	27 zloty
Roumania	675 leu
Russia	6 roubles
Venezuela	11 bolivar

Remittances or drafts should be drawn to the order of the Publisher, World Petroleum, payable in New York and London.

Subscriber's name and address should be in Roman capitals on the subscription order.

Official position of subscriber is requested.

Advance notice, if possible, of a change of subscriber's address should be given.

AGENCIES

Single copies of World Petroleum are obtainable every month, within the delay imposed by the international mail service, at any of the following agencies:

Maracaibo, Venezuela—High Life Tailors.
The Hague, Netherlands—Martinus Nijhoff, Lange Voorhout 9
London—World Petroleum, Brettenham House Lancaster, Place, W. C. 2.
A. C. Hardy, 110 Fenchurch St. E. C. 3
W. H. Smith & Sons, Ltd., Moorgate Met. Station
Willing & Co., Ltd., Moorgate Met. Station
Barker & Howard, 6 Fenchurch Buildings, E. C. 3
New York—Telephone Rector 2-2043 for list of 20 newsstands carrying copies
Paris—Librarie Brentano, 37 Avenue de l'Opera.
Port of Spain, Trinidad—Davidson & Todd, Ltd., 8 Frederick St.
Los Angeles—412 West 6th St., telephone: Mutual 1391.

British subscribers may make payments at the London office of World Petroleum. Monthly copies, two shillings; yearly, one guinea.

PARTICULAR NOTICES

Manuscripts and photographs submitted to the editor are received only at the owner's risk. Prompt consideration will be given to them.

The Publisher does not necessarily endorse the views expressed by authors of signed articles. In the service of readers he will not hesitate to give publication to signed opinions in direct opposition to his own.

Advertising rates obtainable on request.

COPYRIGHT

Copyright, 1941, by Russell Palmer estate. Contents may not be reproduced without permission.

Bayway, site of one of the world's most complete and diverse petroleum research laboratories directed by Standard Oil Development Co. Photo by Ewing Galloway.

EDITORIAL

SABOTAGE BY THE BUREAUCRATS

OVER and over again since the inauguration of the war preparedness program in midyear 1940 the oil industry of the United States has demonstrated its willingness and ability to meet every demand that the exigencies of national defense might put upon it. Through resolutions and other official expressions its various associations, national and local, have expressed their readiness to place their entire resources at the service of the nation. The American Petroleum Institute, largest and most widely representative of these organizations, set up a special committee to cooperate with the national government in providing a prompt and adequate supply of all products that might be needed. Able men drawn from the various branches of the industry are contributing their services to the Defense Council and to the other government departments and bureaus in Washington and elsewhere.

For this attitude the members of the oil industry claim no special credit. They are doing their duty in the face of a national emergency just as millions of other Americans are prepared to do. The main respect in which the oil industry differs from some others of strategic importance is not in its eagerness to serve but in its complete preparedness to do so. It does not have to erect new plants, build new machines and train new workers in order to supply an increased output to meet the requirements of nation-wide defense or of all-out war. It has vast reserves upon which to draw at a moment's notice, transportation facilities without equal elsewhere and surplus refining capacity that can quickly be put into operation.

If additions to this equipment are considered desirable to increase the output of products for special wartime users or to deliver them to points dictated by military strategy the industry stands ready to provide these facilities. In fact it has been waiting for months to be informed as to what steps the heads of the military establishment wish it to take. That no clear cut program has been provided thus far has been due to no fault of the industry but has arisen through apparently unavoidable delays in coordinating the demands of different departments in Washington. Notwithstanding this lack of definite leadership many of the larger oil companies are going forward of their own initiative in providing facilities for the manufacture of certain products for which there is little current commercial demand but which they feel will be called for by the expansion of the armed forces of the nation which is now getting under way.

THE OPERATING organization of the oil industry has been an evolution of nearly eighty years. Its facilities have been developed out of experience to fit the needs of producers and consumers. Progress in methods and equipment has led to the continual improvement of products and the constant cheapening of their cost. Scarcely any other important industry can approach the record of petroleum in this respect.

In a time of national emergency one logically would assume that full advantage would be taken of this highly efficient organization as was done in the previous world war and that the efforts of government officials, if they felt it advisable to intervene at all, would be exerted to speed up the machine and make it function even more effectively. On the contrary a certain coterie of Washington bureaucrats, headed by high placed officials, have chosen this time of public preoccupation with measures of defense to attempt fundamental changes in the machinery of the industry in order to bring the whole business of petroleum production and distribution under federal control. The inevitable effect of such changes would be loss in national efficiency. Even if we grant, what no one familiar with the history of government operation of business will admit, that such changes in the management of the oil industry might be desirable under normal conditions, it cannot be questioned that a radical rearrangement of its operating mechanism in this time of stress necessarily would slow down its action and impair its efficiency.

Throughout the eight decades of its commercial existence the oil business has been a pioneering industry. It is still in the pioneering stage. The search for nature's hidden treasures of liquid wealth is more a matter of science and less one of pure chance than it was in the days when production centered along Oil Creek. But it still involves the taking of long chances and all too frequently results only in the loss of large investments. The work of research and experiment to develop new processes and new products is only in its early stages as every investigator will aver. In all its phases the finding and processing of petroleum is an enterprise peculiarly dependent upon private initiative, upon the willingness of venturesome individuals to assume great risks and to beat new pathways to unexplored regions. Its whole spirit is directly opposed to the static atmosphere that envelopes every government controlled business. All this is quite beyond the ken of the theorists and politicians who compose the Washingtonian wrecking crew. They see in oil a strong, progressive and independent industry. These three attributes are enough to make it an attractive hunting ground for ambitious bureaucrats. Not even the clear warning that disturbance of the industry's smooth functioning machinery will hamper the work of national defense restrains them from pressing their attacks on a number of fronts.

RENEWAL of legislative efforts to dismember the industry is signalized by introduction in the two Houses of Congress of bills to prohibit the ownership of pipe lines or tankers by oil companies. This also was one of the original objectives of the anti-trust suit recently brought against oil companies by the Department of Justice but it was eliminated because of the protest of the National Defense Council as to the adverse effect it would have on defense preparations. The Attorney-General warns, however, that this is only a temporary respite.

Whatever may be the legal position of pipe lines and tankers their function economically is to extend the facilities of a refinery to producing areas or to put the output of a producing field within reach of a refinery. Efficient operation of an oil refinery demands access to a regular and dependable supply of crude. Economical operation requires low cost means of transport. That is why all large refineries are so located that they can be served by pipelines or water craft, or both. These are appurtenances as essential as are their power plants and stills. It they were cut off the plant might be placed in a position where it would be unable to function successfully.

As for several years past, however, the main frontal attack on the oil industry by those who desire to see it managed from an executive department in Washington is conducted through agitation for the legislative extension of federal authority. The demand for such a measure is now put on the ground that it is needed to promote uniform standards of production and to enforce measures for the avoidance of waste within the states. This of course is far from representing the ultimate aim of the ardent advocates of nationalized industry. It will answer their purpose as an entering wedge and is clothed in a form considered least likely to arouse strong opposition. Its supporters agree, however, that if conflict between state and federal governments arises under the proposed law the latter must prevail, an admission which definitely assures the ultimate elimination of all state authority.

SECRETARY of Interior Ickes who has been the leading proponent of federal control of oil since the collapse of the National Industrial Recovery Act, under the terms of which he exercised administrative authority over the industry, has renewed his advocacy of this extension of federal authority. To support his position he raises the outworn cry of waste and stresses the need for use of the strong arm of the federal government to conserve the petroleum resources of the country.

It is regrettable that in all the many hearings on oil that are recorded in tomes of published documents the real story of oil conservation has never been told. The truly remarkable record made by the oil industry of its own initiative, through the millions of dollars it spends yearly in research and through its encouragement to men of inventive genius, in improving processes and turning waste materials into products of the highest usefulness, is a story of epic achievement more interesting than a romance. Beside the actual accomplishments of the oil industry in practical conservation through making each unit of material perform twice the work of which it formerly was capable, in finding new uses for its by-products, thereby establishing new industries, and in turning every part of its output to some highly useful purpose, all that has been accomplished by government or that could be accomplished under its direction pales to insignificance.

This is a story that should be put before the general public which, naturally enough, knows little of the vast expenditure of money and effort that has gone into the conquest of waste, the improvement of products and the reduction of costs, all of which have combined to give the consumers of petroleum products a service that enhances their comfort and efficiency in a score of ways. The real job of conservation is being done by the oil industry itself. If the facts were made known, the persistent charge of ruthless waste would bring only the hollow echo that its falsity deserves.

WORLD CRUDE PRODUCTION UP 3.33%

Despite War and Decreased Production in Many Countries, World Production at 2,146 Million Bbl. is Up 69 Million Bbl. in 1940 Compared With 1939—Soviet Union, Second Largest Producer, Shows Slight Gain Over 1939—Venezuela, Roumania and Iraq Show Substantial Declines—Lack of Official Confirmation from Many Countries Makes Greater Margin of Error Possible for Preliminary Figures.

LACK of official confirmation on preliminary estimates of crude production for the world by countries appearing on the following two pages is an important factor to bear in mind in the analysis of this year's totals presented herewith by WORLD PETROLEUM. Where unofficial estimates are used, however, every effort has been made to check these figures from various independent sources and it may be assumed that they are as accurate as possible within the limitations imposed by upset world conditions.

The annual crude oil production chart as compiled by WORLD PETROLEUM accompanies this article, showing preliminary totals for the more important producing countries, as well as the percentage of world production contributed by continents. Areas in red indicate decreased production compared with the preceding year, while countries shown in black represent increased production compared with 1939.

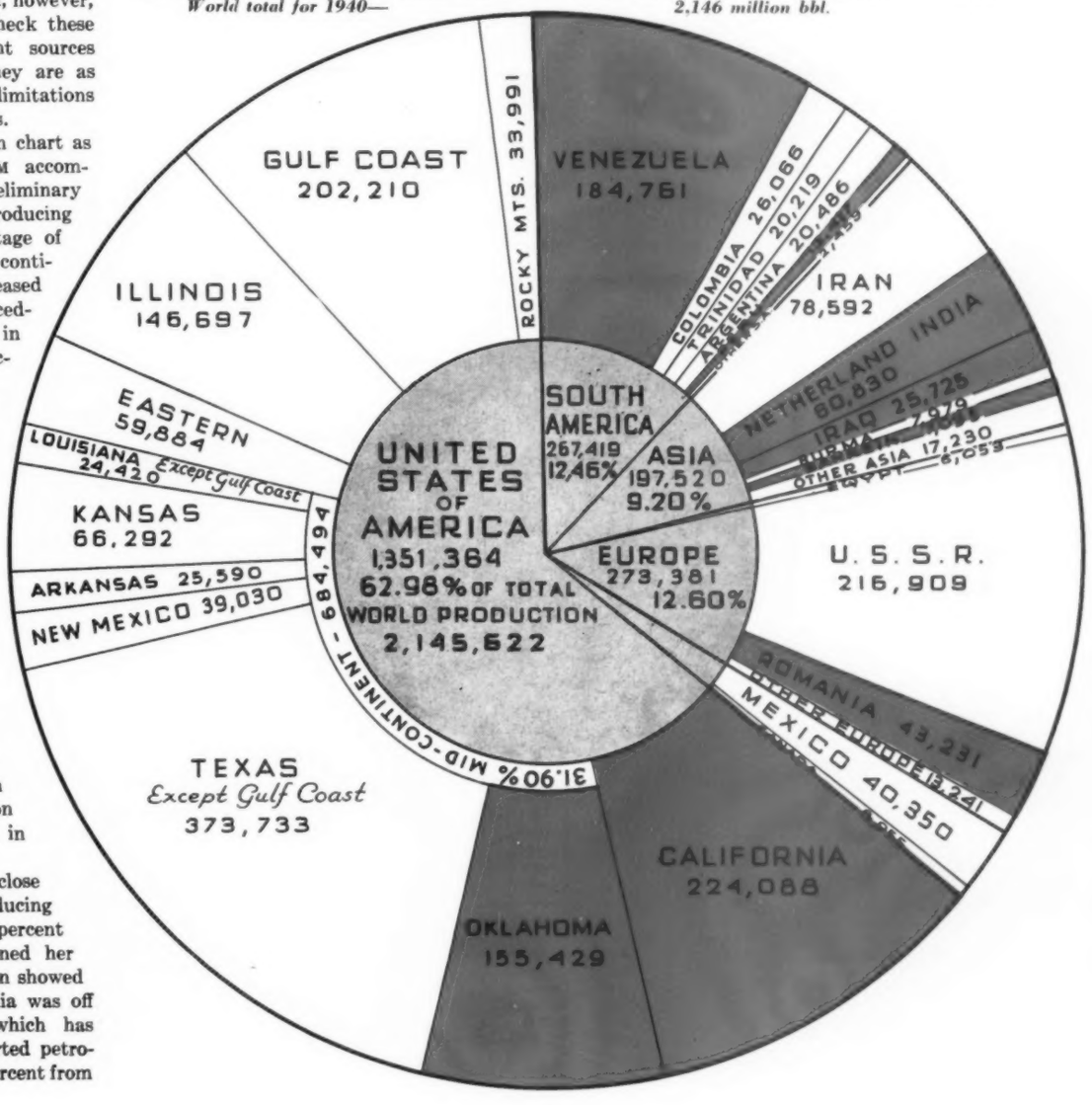
The United States, which in 1940 was responsible for 63.00 percent of the world's crude oil production, increased its output by 6.83 percent from 1,265 million bbl. in 1939 to 1,352 million bbl. in 1940. This increase was the principal factor responsible for the increased world output, the rest of world outside the United States having actually reduced production by 2.11 percent compared with 1939. Crude oil production outside the United States amounted to 811 million bbl. in 1939 and dropped 17 million bbl. to a total of 794 million bbl. in 1940.

Venezuela, which in 1939 was a close third after Russia in the list of producing nations, dropped off by 10.21 percent while the Soviet Union maintained her position with a small increase. Iran showed a small decrease, Netherland India was off 2.02 percent and Roumania, which has become the main source of imported petroleum for Germany, declined 5.88 percent from 1939 production. Iraq suffered most severely, probably due to the closing down of one branch of the pipeline to the Mediterranean; production in that country appears to have dropped 16.45 percent in 1940 compared with 1939.

In South America, Colombia showed the principal increase in production being up 18.28 percent largely as a result of the first full year of operation of the Barco pipeline which was bound to add substantially to the output of Colombia. Argentina increased production by 9.38 percent and Canada showed an increase of 14.27 percent which will probably be improved upon when 1941 figures are available for comparison with 1940 figures. Trinidad production increased 4.92 percent and Egyptian production was up 31.47 percent compared with 1939.

On the following two pages detailed production figures by months and by years for the more important producing countries are reproduced in barrels and in metric tons. Arranged by countries in order of importance.

Chart based on preliminary world crude oil production data; red areas indicate decline in production compared with 1939, black areas indicate increase in production compared with 1939. World total for 1940— 2,146 million bbl.



WORLD OIL

Figures in U. S. barrels of 42 Gallons — Conversi

U. S. BARRELS

	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	July 1940	August 1940	Sept. 1940	Oct. 1940	Nov. 1940	Preliminary Figures Dec. 1940
United States	113,140,700	108,668,800	120,075,000	116,046,000	118,283,000	111,690,000	113,244,000	110,523,000	109,337,000	113,418,000	106,904,000	110,034,5
Soviet Union	18,406,932	17,251,723	18,454,796	17,896,740	18,448,875	18,250,000	18,200,000	18,000,000	18,000,000	18,000,000	18,000,000	18,000,0
Venezuela	14,798,667	14,380,134	15,514,962	16,495,995	18,343,406	18,629,609	16,580,129	15,134,616	14,623,146	13,828,100	13,192,632	13,239,8
Iran	6,637,503	6,227,895	6,745,073	6,507,180	6,560,000	6,449,520	6,664,504	6,700,000	6,700,000	6,700,000	6,700,000	6,000,0
Netherland India: Sumatra	3,472,786	3,149,536	3,440,792	3,428,880	3,456,624	3,345,120	3,456,624	3,456,624	3,345,000	3,345,000	3,345,000	3,345,0
Borneo	1,093,743	1,062,210	1,097,516	1,063,890	1,106,080	1,070,400	1,106,080	1,106,080	1,070,400	1,070,400	1,070,400	1,070,4
Java	561,064	507,207	562,665	537,720	555,582	537,660	555,582	555,582	537,600	537,600	537,600	537,6
Molucca and Other	59,215	62,340	54,021	67,740	62,310	60,300	62,310	62,310	60,300	60,300	60,300	60,3
Rumania	3,786,908	3,595,888	3,818,554	4,422,721	3,830,236	3,682,618	3,812,557	3,864,721	3,253,201	3,063,725	3,000,000	3,100,0
Mexico	3,348,682	3,147,385	3,286,000	3,180,000	3,412,000	3,873,720	2,945,000	3,410,000	3,400,000	3,472,000	3,400,000	3,475,0
Iraq	2,615,129	2,461,723	2,666,713	2,578,020	2,644,362	2,559,060	2,200,000	2,000,000	1,500,000	1,500,000	1,500,000	1,500,0
Colombia	2,478,000	2,025,618	2,203,272	2,229,000	2,428,000	2,276,000	1,956,000	2,110,000	2,169,000	2,192,000	2,000,000	2,000,0
Trinidad	1,636,645	1,529,808	1,633,421	1,580,940	1,634,754	1,659,000	1,684,000	1,710,000	1,750,000	1,800,000	1,800,000	1,800,0
Argentine	1,671,378	1,535,460	1,682,029	1,616,171	1,684,641	1,677,338	1,762,206	1,746,543	1,785,000	1,775,000	1,775,000	1,775,0
Peru	1,154,037	1,071,869	1,139,932	1,097,400	1,143,466	1,106,580	1,143,466	1,143,466	1,106,600	1,106,600	1,106,600	1,106,6
Bahrein	631,644	581,255	636,577	579,078	616,174	602,560	620,486	622,443	598,924	393,634	559,595	653,0
Burma	666,810	629,039	689,750	666,810	679,520	657,600	679,520	679,520	657,600	657,600	657,600	657,6
Canada	486,859	655,586	570,131	634,869	676,486	657,098	877,133	868,651	841,752	817,596	893,438	975,0
Brunei	488,777	456,576	487,661	471,540	487,940	472,200	487,940	487,940	472,200	472,200	472,200	472,2
Great Germany: Old Reich	381,114	360,383	386,508	371,610	384,183	371,790	384,183	384,183	380,000	380,000	380,000	380,0
Ostmark	58,869	57,072	61,721	61,230	61,194	59,220	61,194	61,194	59,200	59,200	59,200	59,2
Slovakia and Moravia	10,137	9,454	10,106	9,780	10,106	9,780	10,106	10,106	9,800	9,800	9,800	9,8
Poland	331,049	310,155	331,669	320,790	331,421	320,730	331,421	331,421	320,700	320,700	320,700	320,7
Japan	225,308	210,801	224,068	216,960	224,719	217,470	224,719	224,719	217,470	217,470	217,470	217,4
British India	197,532	180,351	189,999	180,090	191,611	185,430	191,611	191,611	185,400	185,400	185,400	185,4
Ecuador	204,509	188,024	211,610	208,513	213,000	201,650	207,700	210,676	208,399	226,142	160,775	168,0
Saudi Arabia	491,663	323,416	606,201	476,359	334,728	356,571	478,243	425,829	467,900	467,900	467,900	467,9
Sarawak	112,716	104,951	112,282	108,330	112,282	108,660	112,282	112,282	108,700	108,700	108,000	108,0
Egypt	438,367	450,000	455,000	460,000	465,000	465,000	470,000	475,000	500,000	575,000	650,000	650,0
Italian Empire: Albania	118,358	112,230	123,411	119,250	121,241	117,330	123,432	126,768	130,104	166,800	200,160	200,1
Italy	6,650	6,000	5,500	5,000	5,000	4,400	4,400	4,400	4,000	4,000	4,000	4,0
France	42,532	39,817	42,439	41,100	42,470	41,100	42,470	42,470	41,100	41,000	40,000	39,9
Hungary	90,000	100,000	110,000	120,000	135,000	150,000	160,000	170,000	180,000	180,000	180,000	180,0
Bolivia	8,556	7,975	8,587	8,310	9,000	9,500	8,556	10,000	10,000	10,000	10,000	10,0
Other Countries	49,073	45,849	49,786	48,150	49,383	47,790	49,383	49,383	47,800	47,800	47,800	47,8
WORLD TOTAL	179,901,912	171,506,530	187,687,752	183,856,166	188,743,794	181,922,804	180,897,237	177,010,956	174,078,376	177,209,667	170,015,570	172,790,4

Where official figures are unobtainable because of existing conditions estimates based on best available private information are given.

Daily Averages in Barrels

	Jan.—Dec. 1940	1939
United States	3,692,248	3,465,657
Soviet Union	592,647	593,772
Venezuela	504,812	563,790
Iran	214,731	214,113
Netherland India: Sumatra	110,893	113,854
Borneo	35,485	35,960
Java	17,850	17,996
Molucca and Other	1,999	2,262
Rumania	118,117	125,840
Mexico	110,245	108,022
Iraq	70,286	84,359
Colombia	71,221	60,374
Trinidad	55,242	52,795
Argentine	55,972	51,336
Peru	36,684	37,227
Bahrein	19,386	20,790
Burma	21,800	21,107
Canada	24,466	21,472
Brunei	15,654	15,800
Great Germany: Old Reich	12,415	12,294
Ostmark	1,963	1,899
Slovakia and Moravia	324	327
Poland	10,632	10,679
Japan	7,209	7,268
British India	6,147	6,232
Ecuador	6,418	6,334
Saudi Arabia	14,657	10,561
Sarawak	3,598	3,642
Egypt	16,539	11,517
Italian Empire: Albania	4,553	3,809
Italy	156	250
France	1,356	1,372
Hungary	4,795	2,233
Bolivia	301	276
Other Countries	1,584	1,583
WORLD TOTAL	5,862,354	5,688,779

Official Crude Oil Production Figures for 1934 to 1940 (Preliminary) in Barrels

	1940	1939	1938	1937	1936	1935	1934
United States	1,351,364,000	1,264,962,000	1,214,355,000	1,279,160,000	1,098,516,000	996,596,000	908,065,000
Soviet Union	216,909,066	216,727,024	206,192,000	201,856,661	199,635,921	184,008,033	175,635,783
Venezuela	184,761,241	205,783,650	188,429,050	187,675,477	155,270,840	148,809,057	136,098,681
Iran	78,591,675	78,151,332	78,320,840	78,109,001	62,977,950	57,520,488	57,902,092
Netherland India: Sumatra	40,586,986	41,557,013	34,538,128	33,451,511	30,469,428	28,004,595	26,336,011
Borneo	12,987,599	13,125,425	12,812,383	12,960,072	13,068,910	13,529,185	14,335,543
Java	6,523,462	6,568,714	6,955,283	7,152,931	3,618,293	3,462,440	3,778,920
Molucca and Other	731,746	836,144	607,622	537,436	375,823	311,872	273,698
Rumania	43,231,129	45,931,846	48,366,000	52,395,725	63,532,846	61,270,072	61,849,306
Mexico	40,349,787	39,428,141	38,505,824	46,455,687	41,027,915	40,240,563	38,171,946
Iraq	25,725,007	30,791,132	32,404,000	30,603,660	29,913,150	27,410,983	7,639,840
Colombia	26,066,890	22,036,613	21,581,588	20,297,543	18,756,110	17,597,655	17,337,900
Trinidad	20,218,568	19,270,256	17,736,176	15,502,989	13,237,030	11,671,224	10,894,363
Argentine	20,485,766	18,738,003	17,076,237	16,354,717	15,457,960	14,297,025	14,021,901
Peru	13,426,616	13,587,906	15,908,279	17,459,112	17,593,069	17,056,555	16,314,381
Bahrein	7,095,370	7,588,554	8,297,998	7,762,264	4,644,635	1,264,807	285,072
Burma	7,978,969	7,872,981	7,499,498	7,847,553	7,587,718	7,181,113	7,278,859
Canada	8,954,599	7,837,503	6,965,457	2,996,033	1,507,931	1,447,204	1,410,896
Brunei	5,729,374	5,767,227	5,387,214	4,397,038	3,296,938	3,302,905	2,705,350
Great Germany: Old Reich	4,543,954	4,487,491	3,850,044	3,148,300	3,076,858	2,967,438	2,204,402
Ostmark	718,494	693,247	370,038	221,266	50,092	44,347	27,965
Slovakia and Moravia	118,775	119,380	132,005	123,474	126,603	136,580	177,797
Poland	3,891,456	3,898,044	3,828,438	3,799,862	3,869,575	3,901,881	4,011,336
Japan	2,638,644	2,652,930	2,511,184	2,487,841	2,403,072	2,294,878	1,872,837
British India	2,249,835	2,332,467	2,330,209	2,161,653	1,978,329	2,037,810	1,921,363
Ecuador	2,349,015	2,312,118	2,257,278	2,161,436	1,942,467	1,731,785	1,636,619
Saudi Arabia	5,364,610	3,933,904	495,135	64,968	19,777	Nil	Nil
Sarawak	1,317,185	1,329,645	1,624,882	1,655,565	1,547,882	1,776,593	1,942,591
Egypt	6,053,367	4,603,797	1,561,231	1,163,267	1,262,666	1,255,151	1,527,252
Italian Empire: Albania	1,659,244	1,393,727	437,597	380,292	219,693	41,218	17,500
Italy	57,350	91,330	106,083	112,700	129,653	128,615	162,449
France	496,420	500,815	516,240	507,067	534,063	529,664	700,000
Hungary	1,755,000	815,248	330,829	13,910	100	Nil	Nil
Bolivia	110,484	100,885	106,620	123,123	104,746	163,295	157,875
Other Countries	579,997	578,036	243,000	70,000	37,100	32,300	64,000
WORLD TOTAL	2,145,621,680	2,076,404,528	1,982,639,390	2,041,170,134	1,797,791,150	1,652,023,331	1,516,760,036

PRODUCTION

Conversion ratios used are weighted averages for individual countries

METRIC TONS

	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	July 1940	August 1940	Sept. 1940	Oct. 1940	Nov. 1940	Preliminary Figures Dec. 1940
United States	15,307,901	14,702,854	16,246,164	15,700,987	16,003,653	15,111,622	15,321,877	14,953,727	14,793,266	15,345,420	14,464,077	14,887,633
Soviet Union	2,508,024	2,360,194	2,531,522	2,436,780	2,520,083	2,503,429	2,496,570	2,469,135	2,469,135	2,469,135	2,469,135	2,469,135
Venezuela	2,197,278	2,135,135	2,303,632	2,449,294	2,723,594	2,766,089	2,461,786	2,247,159	2,171,217	2,053,170	1,958,817	1,965,827
Iran	880,493	826,152	894,753	863,190	870,212	855,540	884,058	874,787	874,787	874,787	874,787	783,392
Netherland India: Sumatra	444,602	403,218	440,506	438,960	432,525	426,270	440,479	440,479	426,270	426,300	426,300	426,300
Borneo	140,026	135,989	140,509	136,290	141,608	137,040	141,608	141,608	137,040	137,000	137,000	137,000
Java	71,830	64,935	72,035	68,820	71,114	69,210	71,114	71,114	69,210	69,200	69,200	69,200
Molucca and Other	7,581	7,981	6,916	8,670	7,967	7,710	7,967	7,967	7,710	7,700	7,700	7,700
Rumania	513,479	487,578	517,770	599,691	519,354	499,338	516,957	524,030	441,112	415,420	406,779	420,338
Mexico	492,094	462,171	482,525	466,960	501,028	491,923	432,452	500,734	499,265	509,838	499,266	510,279
Iraq	349,556	330,034	356,531	344,670	353,741	342,330	294,000	267,000	200,000	200,000	200,000	200,000
Colombia	345,606	282,512	307,290	310,878	338,633	317,433	272,803	294,281	302,510	305,718	278,940	278,940
Trinidad	230,206	215,151	229,710	222,360	229,896	233,300	236,800	240,000	246,000	253,165	253,165	253,165
Argentine	238,088	218,726	239,605	230,223	239,977	238,937	251,026	248,795	254,273	252,849	252,849	252,849
Peru	152,737	141,810	150,784	145,200	151,280	146,400	151,280	151,280	146,400	146,400	146,400	146,400
Bahrein	86,195	79,319	87,017	79,022	84,084	82,227	84,673	84,940	81,730	53,716	76,363	89,110
Burma	92,101	86,855	94,147	91,980	93,527	90,510	93,527	93,527	90,510	90,500	90,500	90,500
Canada	61,957	83,429	72,554	80,792	86,088	83,621	111,619	110,543	107,120	104,046	113,697	124,077
Brunei	65,193	60,900	65,038	62,880	65,069	62,970	65,038	65,038	62,970	62,970	62,970	62,970
Great Germany: Old Reich	54,963	51,997	55,800	53,940	55,490	53,700	55,490	55,490	53,700	54,340	54,340	54,340
Ostmark	9,331	9,048	9,827	9,780	9,703	9,390	9,703	9,703	9,390	9,390	9,390	9,390
Slovakia and Moravia	1,519	1,421	1,519	1,470	1,519	1,470	1,519	1,519	1,470	1,470	1,470	1,470
Poland	44,392	41,644	44,516	43,050	44,454	43,020	44,454	44,454	43,000	43,000	43,000	43,000
Japan	32,178	30,131	32,023	31,020	32,085	31,050	32,085	32,085	31,000	31,000	31,000	31,000
British India	27,280	24,911	26,226	24,870	26 443	25,590	26,443	26,443	25,590	25,600	25,600	25,600
Ecuador	26,962	24,788	27,898	27,490	28 081	26,585	27,362	27,775	27,475	29,814	21,196	14,240
Saudi Arabia	66,604	43,812	82,120	64,531	45,344	48,304	64,785	57,685	63,400	63,400	63,400	63,400
Sarawak	14,539	13,543	14,415	13,920	14,446	13,980	14,446	14,446	14,000	14,000	13,370	13,370
Egypt	62,606	64,267	64,981	65,695	66,409	66,409	67,123	67,837	71,408	82,119	92,830	92,830
Italian Empire: Albania	17,670	16,762	18,415	17,790	18,073	17,790	18,500	19,000	19,500	25,000	30,000	30,000
Italy	820	750	680	620	620	540	540	540	500	500	500	500
France	5,952	5,568	5,952	5,760	5,952	5,760	5,952	5,952	5,760	5,760	5,610	5,600
Hungary	12,100	13,450	14,800	16,140	18,160	20,180	21,525	22,870	24,200	24,200	24,200	24,200
Bolivia	992	928	992	960	992	1,166	1,231	1,394	1,394	1,400	1,400	1,400
Other Countries	6,975	6,525	7,006	6,780	7,223	6,810	7,223	7,037	6,800	6,800	6,800	6,800
WORLD TOTAL	24,569,830	23,434,488	25,646,178	25,121,463	25,808,427	24,837,643	24,734,035	24,180,374	23,778,612	24,195,127	23,212,051	23,591,955

Daily Averages in Metric Tons

	Jan.—Dec. 1940	1939
United States	499,560	468,910
Soviet Union	81,153	80,904
Venezuela	74,953	83,996
Iran	28,485	28,403
Netherland India: Sumatra	14,131	14,576
Borneo	4,543	4,603
Java	2,286	2,307
Molucca and Other	255	290
Rumania	16,015	17,063
Mexico	15,979	15,874
Iraq	9,393	11,276
Colombia	9,933	8,404
Trinidad	7,767	7,426
Argentine	7,973	7,280
Peru	4,853	4,927
Bahrein	2,645	2,864
Burma	3,000	2,915
Canada	3,113	2,730
Brunei	2,087	2,105
Great Germany: Old Reich	1,785	1,774
Ostmark	311	301
Slovakia and Moravia	49	49
Poland	1,426	1,432
Japan	1,029	1,039
British India	848	866
Ecuador	846	840
Saudi Arabia	1,985	1,440
Sarawak	460	469
Egypt	2,362	1,801
Italian Empire: Albania	675	569
Italy	19	31
France	190	194
Hungary	644	301
Bolivia	39	33
Other Countries	227	224
WORLD TOTAL	799,943	777,998

Official Crude Oil Production Figures for 1934 to 1940 (Preliminary) in Metric Tons

	1940	1939	1938	1937	1936	1935	1934
United States	182,839,181	171,152,192	164,346,325	172,822,797	148,707,864	134,912,143	122,913,903
Soviet Union	29,702,277	29,530,168	28,859,000	27,867,025‡	27,384,900	25,241,100	24,092,700
Venezuela	27,432,998	30,533,706	27,845,286	27,733,926	22,945,299	21,990,373	20,112,115
Iran	10,425,531	10,367,117	10,358,495	10,330,480	8,329,289	7,607,500	7,657,970
Netherland India: Sumatra	5,172,209	5,320,320	4,662,836	4,490,137	4,114,710	3,759,006	3,535,035
Borneo	1,662,718	1,680,377	1,719,783	1,739,607	1,773,545	1,815,998	1,924,234
Java	836,982	842,237	933,595	960,125	499,097	464,757	510 320
Molucca and Other	93,569	107,047	81,560	72,139	50,446	41,862	36 738
Rumania	5,861,846	6,228,047	6,603,000	7,153,000	8,704,000	8,394,000	8,473,355
Mexico	5,848,535	5,794,035	5,716,423	6,896,657	6,090,842	5,973,955	5,666,857
Iraq	3,437,862	4,115,845	4,345,000	4,126,185	4,079,066	3,724,231	1,048,108
Colombia	3,635,544	3,067,568	3,007,935	2,844,251	2,614,092	2,452,635	2,416,432
Trinidad	2,842,918	2,710,515	2,472,943	2,181,676	1,862,796	1,642,446	1,533,122
Argentina	2,918,197	2,657,232	2,432,857	2,330,063	2,202,304	2,036,903	1,997,706
Peru	1,776,371	1,798,557	9,099,885	2,313,691	2,331,454	2,260,903	2,161,990
Bahrein	968,396	1,045,391	1,130,734	1,058,557	635,555	173,072	39,008
Burma	1,098,184	1,087,424	1,039,960	1,083,391	1,047,593	991,456	1,004,951
Canada	1,139,543	997,487	879,921	378,478	190,495	182,820	178,233
Brunei	764,006	768,320	707,123	576,545	470,991	471,842	386,478
Great Germany: Old Reich	653,590	647,337	552,074	453,451	444,600	427,400	317,500
Ostmark	114,045	109,904	63,468	33,010	7,473	6,616	4,172
Slovakia and Moravia	17,836	18,103	19,282	18,036	18,665	19,946	25,971
Poland	521,984	522,874	504,678	501,301	510,630	614,760	529,200
Japan	376,657	379,161	356,328	341,040	341,976	326,580	266,520
British India	310,596	322,160	322,125	298,450	273,137	281,072	265,341
Ecuador	309,686	306,824	319,877	306,326	275,293	245,434	231,947
Saudi Arabia	726,785	536,366	66,683	8,070	2,447	Nil	Nil
Sarawak	168,475	171,322	200,126	217,085	221,126	253,799	277,513
Egypt	864,514	657,570	223,058	166,298	177,491	176,436	214,671
Italian Empire: Albania	248,500	208,279	65,313	56,760	32,760	6,152	2,500
Italy	7,110	11,346	13,178	14,000	16,106	15,977	20,180
France	69,578	70,478	72,106	71,008	74,788	74,172	98,025
Hungary	236,025	109,896	42,798	13,910	13	Nil	Nil
Bolivia	14,249	11,998	13,262	15,487	13,197	20,340	19,858
Other Countries	82,779	82,300	34,000	10,000	5,300	4,600	9,100
WORLD TOTAL	293,179,276	283,969,503	279,111,097	279,482,962	246,449,340	226,610,486	207,971,753

Broadening Field of INTERSTATE COMPACT

By J. C. Hunter

Through Factual Studies and Recommendation of Practical Methods of Proration Compact Commission Can Encourage Uniformity in State Laws and Regulations — Full Cooperation of State Authorities and Industry Will Provide Effective System of Conservation.

THOSE who are familiar with the activities of the Interstate Compact Commission are convinced, I am sure, that it has rendered valuable service to the cause of petroleum conservation and to the encouragement of sound methods of dealing with this question on the part of oil producing states. Of late there has been a growing feeling, however, that the Compact, without abandoning its primary purpose, is capable of occupying a broader field of usefulness than it has filled in the past.

Numerous suggestions have been put forward as to how the Compact might be made more effective in furthering a sound and equitable conservation program. These suggestions have been weighed and some of them have been adopted. One of these took form recently with the submission by the Commission's legal committee of the draft of a measure that might serve as a standard by which the various states could measure or test new conservation legislation or the revision of existing laws. This has been referred to in some press reports as a model law, a term that may be misleading in that it is not expected that it will be adopted *in toto* by a state but rather in order to indicate the points that should or might with advantage, be covered in any enactment adopted.

This, it seems to me, indicates a line of activity in which the Interstate Compact Commission can be most useful. That is, in studying the problems of conservation and making recommendations not only in the field of possible legislation but possibly in those of engineering and field practice as well. Since these suggestions would have to stand or fall on their own merit there could be no question of any invasion or abrogation of the rights and powers of state and local governments. They would have no force except that derived from experience and no weight except that attaching to them as the measured opinions of competent and recognized authorities on the subject involved.

This is an important point. The Commission does not seek and in my opinion should not seek a broadening of its powers. That was the conclusion of the compact redrafting committee which I recently had the honor of submitting to the Commission. As it stands the Commission is a recognized public body. Its creation was authorized by Congress to permit a certain degree of cooperation along well defined lines by interested states. Its functions are permissive and advisory only. To attempt to make them mandatory would be to depart from the underlying principle upon which the Compact is based and to move toward that centralization of power to which the oil producing states and, I think, a great majority of the members of the oil industry are fundamentally opposed. It is for this reason that the Commission, very properly, is disposed to move carefully in any broadening of its operations in order not to overstep the boundaries which the desire of its own members as well as the will of Congress set for it.

It was the opinion of the redrafting committee that the Compact Commission could best perform its duty by making continued and comprehensive studies of the problems of conservation, and through conference and consultation with regulatory bodies and other public officials, as well as those engaged in the production of oil and gas, furnishing them with the information and viewpoints resulting from such investigation and studies, and recommending to the states and the oil producing industry, careful consideration of the findings made by the Commission through its committees.

The Compact Commission should function in a broad and efficient manner as a fact-finding body. Such performance, coupled with appropriate recommendations to the several states, can be of material benefit to the producing states and the oil industry in the accomplishment of a successful conservation program. Responsibility for the enactment of adequate conservation law under the police power of the respective states rests upon the state legislatures, and the Compact Commission can assist by making available to the states suggested provisions of law which experience in the various producing states has shown to be useful and necessary, as has been referred to previously. In other directions it can study the scientific bases of

California, without state conservation laws, has achieved a measure of stability through voluntary proration.

regulation and the methods that contribute to a sound and equitable system of proration. Thereby, without compulsion, it can promote uniformity of laws and practices in the several states.

Responsibility for administration of the conservation law properly rests with the several regulatory bodies of the respective states. The Compact Commission can be of service to the regulatory bodies through a study now being conducted by a special committee, concerning the administrative rules and practices employed in the states, and also through extensive study being conducted by a special committee of the Compact concerning the engineering standards and practices which have been developed by the oil producing industry. Reports will be made by these committees and submitted to the regulatory bodies for their consideration.

There are at present two well defined schools of thought in the United States as to oil conservation and oil industry operation. One contends that ultimate if not immediate control should be lodged in the federal government. The other holds that such a transfer of authority not only would deprive the states of rights inherently theirs but weaken and presently destroy the spirit of initiative and progressive enterprise that has brought the industry to its present state of high efficiency.

The strongest argument of those who

advocate the extension of federal control and regulation beyond their present limits is the lack of uniformity in state laws and practices. While admitting that certain states are making an honest and successful effort to meet the demands of conservation they point to other states which have not adopted adequate laws to prevent waste or have not set up effective means of enforcement.

Since the Interstate Compact law is a recognition of the primary concern of the states in the matter of conservation the Compact Commission is the logical body to provide leadership for the preservation of state rights and private enterprise. But in order to make that leadership effective the Compact needs full cooperation from the oil industry and the oil producing states. Conservation of oil and gas of course is of vital concern to the national, state and local governments, as well as to every individual citizen. To no one is it more vital than to those engaged in the oil industry. The Compact constitutes one of the outstanding efforts ever undertaken in this country to solve, through a cooperative group of states, the common problem of oil and gas conservation, which deeply affects the interest not only of those states and their citizens, but likewise the interest of the nation as a whole.

In referring to the divergence of views as to the relative desirability of federal or state regulation it is not meant to suggest that sound conservation implies any conflict between the two. There are certain aspects of conservation that are now being effectively handled by agencies of the federal government. Among these may be mentioned the operation of the Connally Hot Oil Act and the statistical services of the Bureau of Mines. Adequate provision has been made by Congress for rendering this service to the states. If the latter fulfill the functions that traditionally belong to them it cannot be doubted that such cooperation will result in the most nearly perfect conservation program that it is legally possible to devise. If the Interstate Compact Commission can contribute to such an outcome, as I believe it can, it will have rendered a service of the greatest value to the oil industry and the nation.

It is the spirit and purpose behind the Interstate Oil Compact that it function as a fact-finding, recommending, and coordinating agency to the end that the states can thereby perform the best and most practical job of conservation. It is proper to assume that we have in the oil producing states a capable and patriotic citizenship who sincerely desire to handle in the best practical manner this great problem of oil and gas conservation, which is fully recognized as imperatively necessary to the general welfare, both nationally and in the oil producing states, and is equally important to those who are interested in oil production and the distribution thereof. If this assumption is true, there is no reason to doubt that the oil industry and the oil producing states, through their public officials and through the Interstate Compact Commission, can achieve all that is desirable and practical in a conservation program. It is the feeling of the personnel of the Compact Commission, and I firmly believe that such feeling is shared by an over-whelming majority of the oil industry and the state officials, that the Interstate Compact can aid materially in bringing about the best type of conservation program and making a substantial contribution to its efficient and effective administration. The Compact was not created for, nor is it functioning for, the purpose of imposing its judgment or wishes upon other conservation agencies nor preventing the establishment of any such agencies.

The purpose of its membership is to perform the functions set out in the Compact charter. It strives to bring about through fact-finding studies, coordination, and recommendations, a sound, efficient, and practical conservation program, and naturally, if such objective is achieved through the efforts of the states individually and collectively, no other conservation agencies are necessary.

White House Calls Attention to Pipe Line Obstruction

WASHINGTON, Feb. 6.—In the discussion of other phases of the preparedness situation relatively little notice has been directed to petroleum affairs of late. Public attention was recalled to the subject today, however, by release of a letter addressed to Chairman Lea of the House Interstate Commerce Committee by President Roosevelt. In this letter the President says:

"The Atlantic Coast area now is dependent upon ocean transportation for nearly its entire supply of crude petroleum and petroleum products. Present facilities for such transportation do not afford much leeway under normal conditions and very likely will prove inadequate in an emergency.

"I have been informed by the government agencies concerned that the completion of one gasoline pipeline and the commencement of another to the southeastern states have been delayed by opposition from other carriers in interstate commerce. Although this situation ultimately might correct itself, delay in its solution will retard the completion of essential transportation facilities."

The only comment of Chairman Lea in making public the letter was a statement that the Cole sub-committee would take up the matter as part of the investigation already authorized by Congress. Mr. Lea said:

"I have requested information about the President's request from both sides of the controversy for the benefit of the committee. I have assured the President that the Petroleum sub-committee, of which William P. Cole is chairman will give proper consideration to the problem before that committee submits its report.

"The committee will go into the facts with a view to determining whether or not there is or should be a legislative remedy provided to meet the situation suggested by the President. Should the inquiry of the Committee convince us that the facts justify or require legislation, I assume an appropriate measure will be recommended."

No further identification of the opposition to construction of pipeline facilities desired by government defense agencies was forthcoming at the Capitol or the White House. Mention of the southeastern states and reference to delay in completion of one undertaking and in the commencement of another indicates rather clearly however the lines which the President had in mind.

One of these presumably is the projected gasoline pipeline of Standard Oil Co. of New Jersey and Shell Oil Co. from Baton Rouge, La., to Charlotte, N. C. This line would pass through six southern states. Construction has been deferred pending settlement of issues raised in connection with the right-of-way laws of Georgia, one of the six states.

The other line, progress on which is stalled by similar difficulties is a joint enterprise of Gulf Oil Corporation and Pure Oil Company for a line from St. Joe on the Gulf Coast of Florida to Atlanta. About 80 miles of this line, from St. Joe to Bainbridge on the Georgia-Florida boundary, has been built but it still has some 300 miles to go across the state of Georgia to reach its destination at Atlanta.

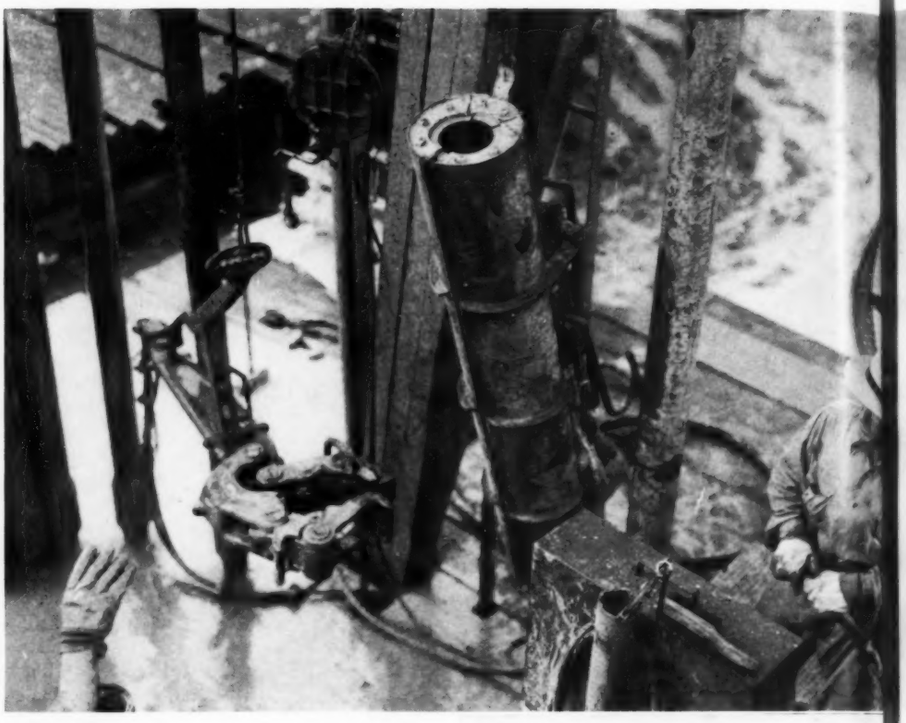
Under Georgia law, influenced perhaps by state ownership of railway lines, railroads have priority in right-of-way matters. The state owns the Atlanta & West Point R. R. which is leased to the Louisville & Nashville and these two roads are understood to have objected to the granting of rights to the oil company pipe lines.

Just what action the Cole Committee could take on a question of this kind is problematical although of course it could recommend special legislation to deal with it. Possibly the President's letter was put out for its moral effect as a warning not to obstruct projects that are a part of the program of national defense. It is not considered here that the building of the two pipe lines referred to can be held up more than temporarily.

HAWKINS FIELD Valuable Addition to Nation's Reserves

By Michael T. Halbouty

Fortunately Less Spectacular Than Early Reports, Which Compared it With East Texas, There is Every Indication that Hawkins Will be Unified and Controlled. Present Estimates Credit Field With 563 Million Barrels.



Active wildcatting in every oil province of the United States failed to reveal a major field until the year was almost over when the Hawkins field in Wood County was discovered.

TOWARD the close of 1940, just as commentators were preparing to view with alarm the failure to uncover any outstanding new reserve, several months work in Wood County, Texas, culminated in the discovery of the Hawkins field. Exaggerated rumors, unjustified on the basis of available information, credited Hawkins with a reserve equal to East Texas and widespread interest was aroused. Investigation now reveals that while the field is in all probability not a second East Texas, it will rank with the important discoveries of the last decade in Texas, Louisiana, and the Mid-Continent.

The Hawkins field is located approximately twelve miles west of the Gladewater district of the East Texas field. The town of Hawkins, which is estimated to be located on top of this newly found structure, is located in the southeastern corner of Wood County. Fairly good roads are present in the area and accessibility is far better than in the average newly discovered field. The Hawkins townsite was planned and laid out by the Texas and Pacific Railroad and the Railroad Company retained the ownership of a large number of the town lots and tracts.

GEOLOGY

The Hawkins Oil Field, Wood County, Texas, is located in what is known geologically as the East Texas Basin. The field is considered to be one found by geophysical methods of exploration. Several companies conducted geophysical work in the area; however, it was the ingenuity and the persistence of the Humble Oil and Refining Company's crews which located and defined the prospect. The Humble Company leased approximately 20,000 acres in the area and attempted to get as much of the acreage as possible into one unbroken block.

Discovery of the Hawkins Field created intense interest. A blow-out occurred near the townsite of Hawkins which made it necessary for the Railroad Commission of Texas to study the available facts in the field in order to promulgate certain rules and regulations for drilling procedure to prevent further blow-outs. A hearing was held on January 20, 1941, by the Railroad Commission at the Hawkins School House, which was attended by 300 citizens as well as representatives of major oil companies and independents.

Testimony presented to the Texas Railroad Commission revealed that the estimated surface productive area would cover from 7,500 acres to 8,000 acres. There is no doubt that this estimate was based on available geophysical information and data obtained from dry holes previously drilled around the prospect.

At the present time, there are only three completed wells and it is impossible to determine how large the field will eventually become. The three producers are (1) Jackson & Rotundi's No. 1 Cobb, which is in the townsite of Hawkins, is officially considered to be the discovery well of the field and was com-

pleted December 28, 1940; (2) the Hollandsworth Oil Company's Robins No. 1; and (3) Bobby Manziel's Morrison No. 1. The Bobby Manziel's Morrison No. 1 is located approximately three miles northwest of the Jackson & Rotundi Cobb No. 1 well and is unofficially

the discovery well of the field. The Morrison well was brought in in October, 1940, as a small pumper, however the well was reworked and was not officially completed until after the Jackson & Rotundi Cobb No. 1 and the Hollandsworth Robins No. 1 were completed as producers. At the end of January, the three wells are producing a total of 400 bbl. per day.

Approximately 5,300 ft. northwest of the No. 1 Cobb, Bobby Manziel's No. 1 well blew out from a depth of 4,363 ft. on December 29, 1940, and was making an estimated 70,000,000 cu. ft. of gas daily with no oil through a flow line connected to surface casing. Steps have since been taken to kill the well.

Testimony at this hearing also revealed that the structure has approximately 800 ft. of closure, of which 500 ft. contains oil and gas. The oil and gas section is in the Woodbine formation. The upper 100 ft. of this 500 ft. were said to contain free gas. The remaining 400 ft. contained oil but the section has a considerable amount of shale. It was estimated from data obtained from the discovery well and the Hollandsworth well that of the 400 ft. of section, 145 ft. would contain effective sand. The depth of the oil producing section in the Woodbine is estimated from 4,390 ft. to 4,790 ft.

The estimated total thickness of the Woodbine formation is from 700 ft. to 750 ft. and the lower 200 to 300 ft. of the section probably contains salt water. The field will be principally water driven, ensuring a similar recovery factor to that of the East Texas Field.

The Railroad Commission of Texas reported bottom hole pressure of 2,026 lbs. tested at 4,200 ft., 168 deg. F. in the Jackson & Rotundi No. 1 Cobb.

It is estimated from the cores and electric logs that the recoverable oil in place is 750 bbl. per acre foot. The oil ranges from 28 deg. to 29 deg. gravity (45.5 octane rating reported). The oil is dominantly asphaltic base. The oil and gas ratio on the existing wells averages 415-1.

The stratigraphy in the area is as follows:

Formation		Ft.
Claiborne	from 0 to	650
Wilcox	to	1400
Midway	to	2173
Navarro	to	2330
Nacatoch	to	2790
Marlbrook	to	3045
Pecan Cap	to	3310
Taylor	to	3658
Lower Taylor	to	3873
Blossom	to	3933
Austin Chalk	to	4325
Sub-Clarksville	to	4357
(Estimated to carry free gas)		
Eagleford	to	4480
Woodbine		

It is estimated that the Woodbine can be found as high as 4,390 ft. or higher. The Nacatoch and Blossom carry salt water. The sands existing from the surface to 1,400 ft. contain fresh water and surface casing will be set through this fresh water horizon which should place the casing seat at the top of the Midway shales which should be from 1,400 ft. to 1,500 ft.

ECONOMICS

Of the estimated 7,500 to 8,000 surface acres said to outline the Hawkins structure, the Humble Oil and Refining Company controls from 90 to 95 percent. The remainder is controlled by other companies and independent operators. The control of such a large percentage of a field of this type by one major company will reduce the hazards and problems which existed in the East Texas Field. Well-spacing has been regulated on a 20-acre pattern: however, exception will probably be made for smaller tracts owned by independent operators. The production for these exceptions will be regulated on a formula based on possibly 50 percent acreage and 50 percent flat per well.

At the hearing conducted by the Railroad Commission, it was recommended by engineers that surface casing should be set 50 ft. in the Midway formation in order to case off all of the fresh water sands which exist above, and prevent pollution of the fresh water sands which are used for domestic water production in the area. The engineers also recommended that the surface casing be 1,200 lb. test and that it be cemented to the surface. The cement should be allowed to set for 24 hours and then tested and if the pressure drops more than 150 lbs. in half an hour, a corrective measure should be taken. It was also recommended by engineers that a 2,000 lb. test pipe should be used for the oil string and that it be set well below the gas-oil contact which was estimated at -4,100 ft., and then cemented 1,200 ft. or 1,400 ft. above the shoe.

It was also recommended by engineers that the drilling mud should be 9½ lbs. to prevent blow-outs and all well-head fittings should be 4,000 lbs. test. Two valves should be placed on the tubing for emergencies and a blow-out preventer should be required. It was recommended by the engineers that the maximum gas-oil ratio allowance should be 1,000/1 or less.

At the hearing, 20 acre spacing for wells in the new Hawkins Field was approved by operators, and at the same time no one offered serious objection to proration on acreage and per well with 50 percent allocated on each factor. On January 24, 1941, the Railroad Commission ordered 20-acre spacing of wells in the oilfield. The order signed by all members of the regulatory body was adopted and a proration form based 50 percent on acreage and 50 percent per well. It permitted a gas-oil ratio of 700 cu. ft. of gas to one barrel of oil.

An estimate of the probable reserves in the Hawkins field may be had by using the following estimates and by employing the volumetric method of estimating oil reserves:

(1) 100 ft. of effective sand.

(2) 750 barrels per acre foot recoverable oil in place.

(3) 7,500 acres.

(4) Same porosity and permeability as East Texas.

(5) Principally water driven.

(6) Low oil and gas ratio.

By the above figures it is estimated that the reserve would be 562,500,000 bbl.

The size of the field and the reserve estimate are far less than anything that may be compared with the East Texas field. For the sake of comparison, it will be remembered that the East Texas field was estimated ultimately to

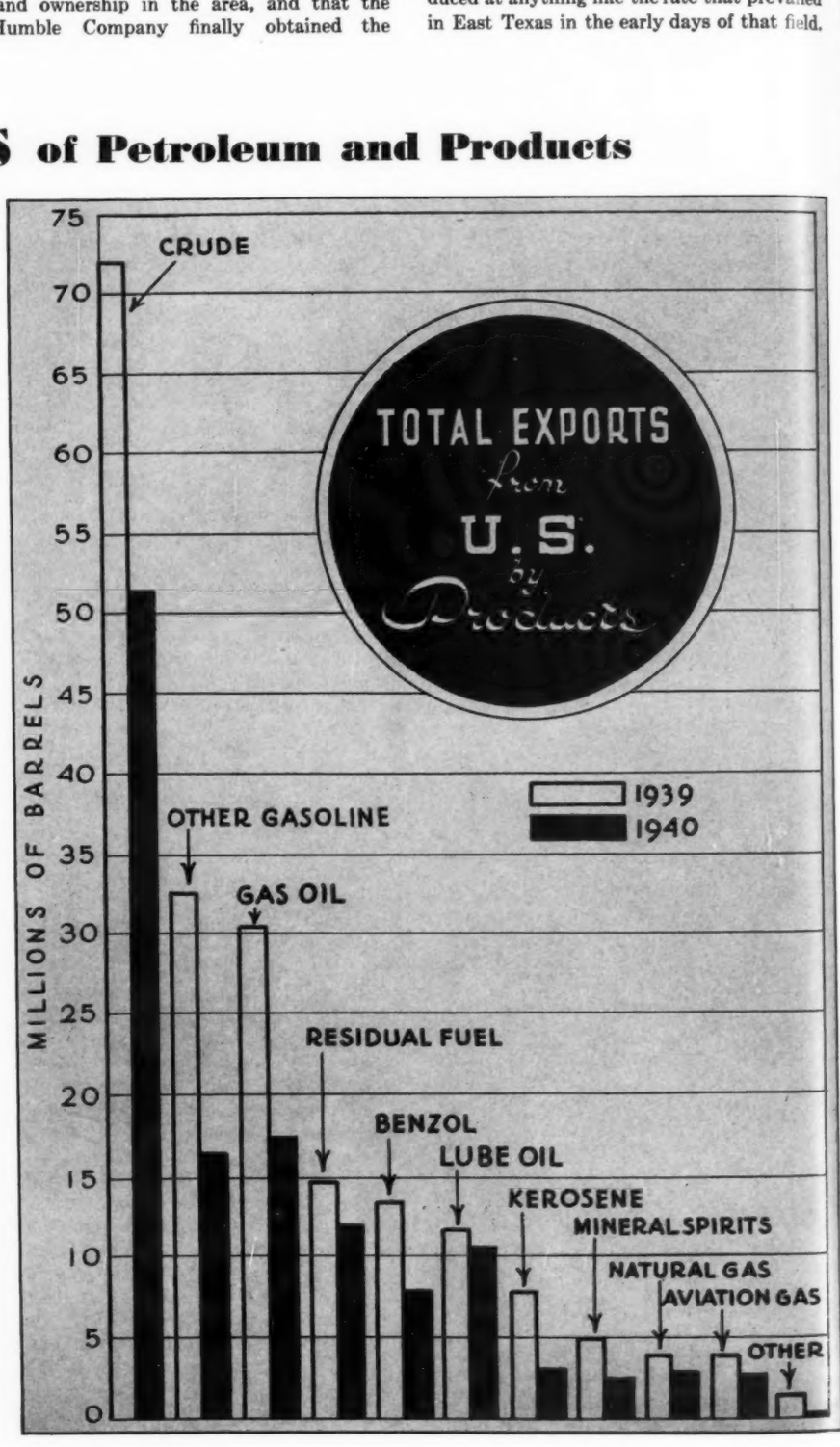
produce 5,000,000,000 bbl. of which already approximately 1,500,000,000 bbl. have been produced. The maximum effective sand thickness in the East Texas field is slightly over 100 ft. in which 150,000 surface acres are involved and on which 26,000 wells have been drilled.

Due to its proximity and similarity of producing horizons and characteristics to East Texas, oil operators in Texas, Louisiana and the Mid-Continent area became tremendously interested in the Hawkins discovery from a geological and economical standpoint. High prices were offered in an attempt to lease any available acreage. Large prices were paid for small tracts and it is rumored that as high as $15,000 was paid for a one-acre tract. The total acreage owned by the Texas-Pacific Railroad Company is 80 acres comprising right-of-way and town lot holdings. It is understood that hundreds of bids were received by the Railroad Company for their land ownership in the area, and that the Humble Company finally obtained the property. It is evident that the Humble Oil & Refining Company is attempting to purchase as much outside acreage as available for considerations probably beyond normal value in order to gain a more unified control over the expected production. It would, of course, put a great additional strain on the industry if it had now to meet conditions that would arise if the Hawkins field were produced at anything like the rate that prevailed in East Texas in the early days of that field.

U. S. EXPORTS of Petroleum and Products Decline 35.41%

War Causes Sharp Falling Off in Shipments to All Countries Except Canada, Australia and Russia—Gasoline Shipments Reduced 49.10 Percent in 1940—Imports Gain 40.52 Percent in Volume—Trend Might Be Changed by Further War Developments.

PETROLEUM exports from the United States for the year 1940 show a decline of 35.41 percent compared with the preceding year thus revealing a trend directly contrary to the general assumption before the outbreak of war. It was assumed prior to 1939 that a general European war, depending to so great an extent on mechanized forces, would bring about a great increase in consumption of petroleum products and that some part of this increase would have to be supplied by exports from the United States. Experience has indicated, however, that there has not been any considerable increase in consumption of petroleum products by the warring nations, partly because the major clash of land forces lasted for so short a time, and because reductions in civilian requirements have been strictly enforced by both sides. Apparently this reduction in civilian demand has been sufficient to offset military needs, either entirely or to a great extent. The British blockade has cut off the Axis powers from the United States market practically entirely, and the Allies have so far depended on British Empire sources in an effort to con-



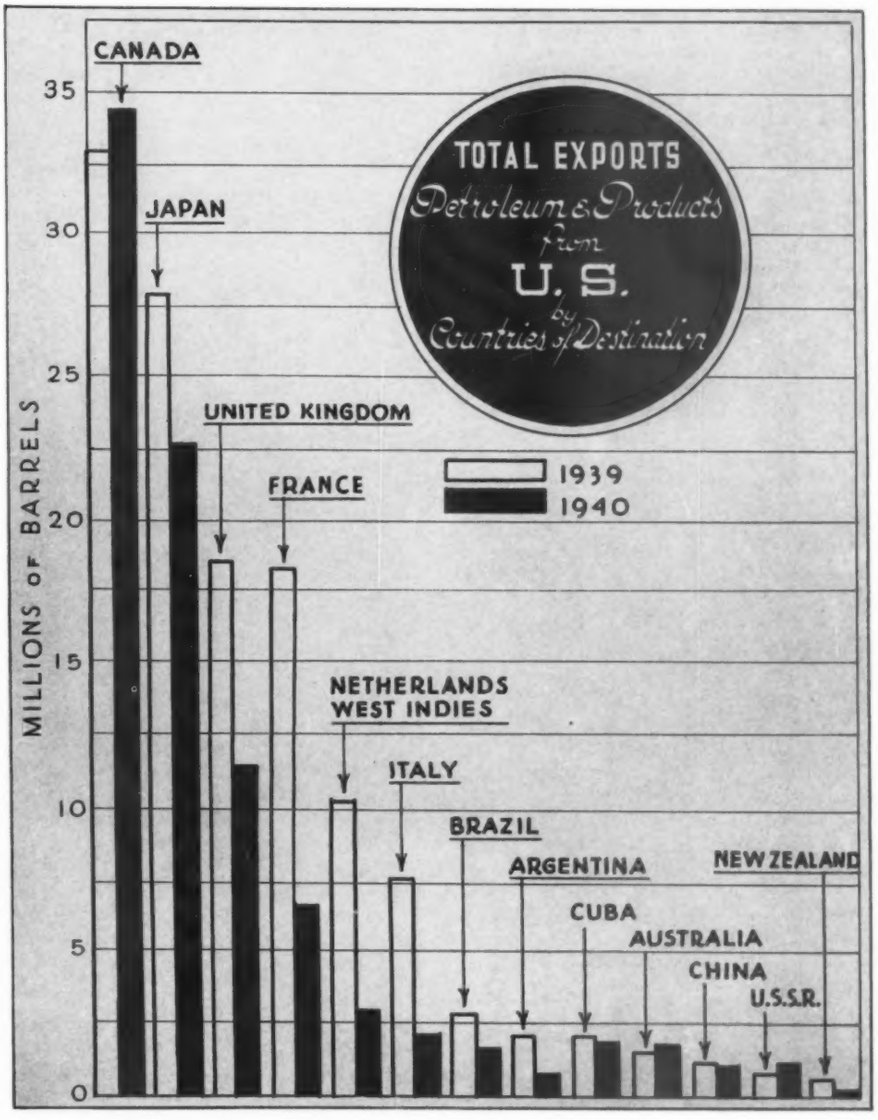
serve dollar exchange for the purchase of aeroplanes and munitions from the United States. In the accompanying table may be seen the effect of the war on exports of petroleum products and on exports by countries of destination. This comparison is further illustrated by accompanying graphs.

United States exports of petroleum and products dropped from 180,009,476 bbl. in 1939 to 116,267,787 bbl. in 1940. Of the 13 principal purchasers of United States products in 1940 only three showed increased shipments from the United States in 1940 as compared with 1939. These three countries were in order of their importance: Canada, Australia and Russia.

Canada taking 34,172,020 bbl. of United States crude and products, or 29.39 percent of entire United States shipments was by far the largest purchaser; and Canada increased her imports of United States products from 32,860,915 in 1939 by 4.23 percent. This very substantial increase was accounted for mainly by larger shipments of residual fuel oil, lubricating oils, and a slight increase in crude oils. It is probably explained by greater industrial activity in Canada as a result of her war effort on behalf of the mother country and by increased bunkering of allied ships carrying munitions and war supplies in the trans-Atlantic trade.

Australia appears to have increased her imports from the United States by 12.47 percent although the amount that country takes from the United States is not of the first importance. During 1939 Australian imports of petroleum and products from the United States amounted to 1,540,341 bbl. while in 1940 this figure was increased to 1,832,132 bbl. Imports of practically all products increased in the case of Australia, some crude being imported against no United States crude the preceding year. Gasoline, distillate and residual fuel oils, lubricating oils and other products all showed increases in shipments from the United States and are probably accounted for by the fact that the United Kingdom was taking larger quantities from Empire sources that ordinarily serve as logical suppliers of distant Australia.

The third country to increase shipments from the United States during 1940 was the Soviet Union. Here the increase amounted to 27.94 percent, but again the amounts involved were not large. During 1939 Russia received 883,534 bbl. of petroleum and products from the United States, while in 1940 these shipments were increased to 1,130,735 bbl. The increase occurred in the gasoline, gas oil and distillate classifications. The substantial percentage increase and the classifications into which it falls appears to have attracted the attention of the State Department and in August 1940 shipments of aviation gasoline, tetraethyl lead and aviation lubricants to Russia were declared to require licenses. There seems to be some ground for believing that United States shipments to the Pacific coast of Russia may have been intended to release some part of Russia's substantial production for shipment to Axis powers,



although large shipments from the Soviet Union to Germany or Italy would not seem particularly practical due to transportation difficulties.

All other countries showed marked decreases in the amounts taken from the United States, Italy and the Netherlands West Indies showing the biggest percentage drops, both having decreased by 71 percent. Since Italy entered the war there have been practically no shipments from the United States and the 2,128,977 bbl. that went to Italy in 1940 practically all went during the first half of the year. Shipments to N. W. I. decreased from 10,542,555 bbl. in 1939 to 2,959,147 bbl. in 1940 largely as a reflection of the dislocation of European markets. Most of N. W. I. supplies come from Venezuela for refining and reshipment to Europe; certain products, however, are imported from the United States to maintain a balance in runs to stills. Thus while no crude was imported in either year, there was some importation of natural gasoline, as well as aviation and other gasolines for blending. Kerosene and distillate fuel oil also are imported to the West Indies probably for further treatment before shipping to Europe. Due to considerably decreased runs to stills both on Aruba and Curacao less of all these products were required from the United States during 1940 than were used in 1939.

As mentioned, the United Kingdom decreased imports from the United States, probably in an effort to conserve dollar exchange; the decrease was of the order of 38.12 percent and involved a drop of 7,108,000 bbl. Japan also showed a substantial decrease in the amount of United States products imported, possibly as a result of the "moral" embargo. Japan, however, was still the second largest purchaser of United States petroleum, taking 22,746,728 bbl. some 18.45 percent less than in 1939.

Shipments to France, of course, have ceased as a result of the British blockade and the year's figures reflect a drop of 63 percent from the 18,312,300 bbl. taken in 1939 to 6,775,228 bbl. during 1940.

Brazil and Argentina, largest South Amer-

ican customers for United States petroleum, also showed substantial decreases, the former falling off 24.66 percent to 1,781,718 bbl. in 1940 and the latter 61.45 percent to 830,225 bbl. These declines are occasioned probably by a shortage of foreign exchange available for such purchases. Argentina has been particularly hard hit by loss of European markets and to some extent the same is true of Brazil. Both countries are engaged in efforts to supply their requirements from indigenous sources. Of the two remaining countries listed in the accompanying table, New Zealand, not an important destination for United States shipments, decreased her imports from the United States by 49.85 percent to 335,024 bbl. in 1940 and China remained about the same, taking 1,145,910 bbl. in 1940 against 1,159,665 bbl. in 1939. Conditions governing imports of United States petroleum products into China were approximately the same in 1940 as they were in 1939, hence the relatively small drop of 1.20 percent.

Viewing United States petroleum export trade from the angle of total products shipped regardless of destination, it is found that all classifications showed decreases, the most serious from a percentage basis being benzol, (-84.14 percent), kerosene (-60.73 percent) and natural gasoline (-58.47 percent). Quantitatively, the drop from 72,063,824 bbl. of crude exported in 1939 to 51,599,402 bbl. exported in 1940 and the drop of 42.61 percent from 30,664,514 bbl. in 1939 to 17,596,828 bbl. of gas oil and distillate in 1940 are by far the most serious. From the point of view of value, the drop in gasoline exports from 32,504,970 in 1939 to 16,542,718 bbl. in 1940, a decline of 49.10 percent is probably the most serious. Lubricating oils, export of which is more diverse as to destination than any other product showed the smallest decline of any important classification, falling only 12.66 percent from 11,864,943 bbl. in 1939 to 10,362,563 bbl. in 1940. Aviation gasoline, in respect to which an increase in exports might reasonably have been expected, actually declined 24.81 percent. The United Kingdom did actually increase shipments of aviation gasoline from 491,481 bbl. in 1939 to 845,977 bbl. in 1940 but shipments to Italy ceased entirely and shipments fell off substantially in the case of France, Netherlands West Indies and Canada. There was a slight decline in the amount of aviation gasoline exported from the United States to Japan, but it amounted only to 3.64 percent.

Imports of crude oil into the United States, coming principally from Venezuela, Colombia and Mexico increased by 40.52 percent in quantity and by 53.97 percent in value from 1939 to 1940. These percentages apply only to imports for immediate consumption; total imports in this category amounted to 28,557,885 bbl., valued at $19,559,108 in 1939 and jumped to 40,231,193 bbl. valued at $30,116,305 in 1940. Imports were stimulated by ratification of reciprocal trade treaties with Venezuela which affected also oil shipments from Colombia and by the near shortage of fuel oil during the severe winter of 1939-1940, when it was found more practical to secure supplies from Venezuela than from the more distant Gulf ports, particularly in view of the increase in tanker rates.

Petroleum entered in bond for re-export, suffered the general fate of the United States export market, this classification dropping off by 71.46 percent in quantity and 69.16 percent in value. Only 1,598,572 bbl. valued at $1,159,977 were entered in bond during 1940 against 5,602,246 bbl. valued at $3,760,648 in 1939.

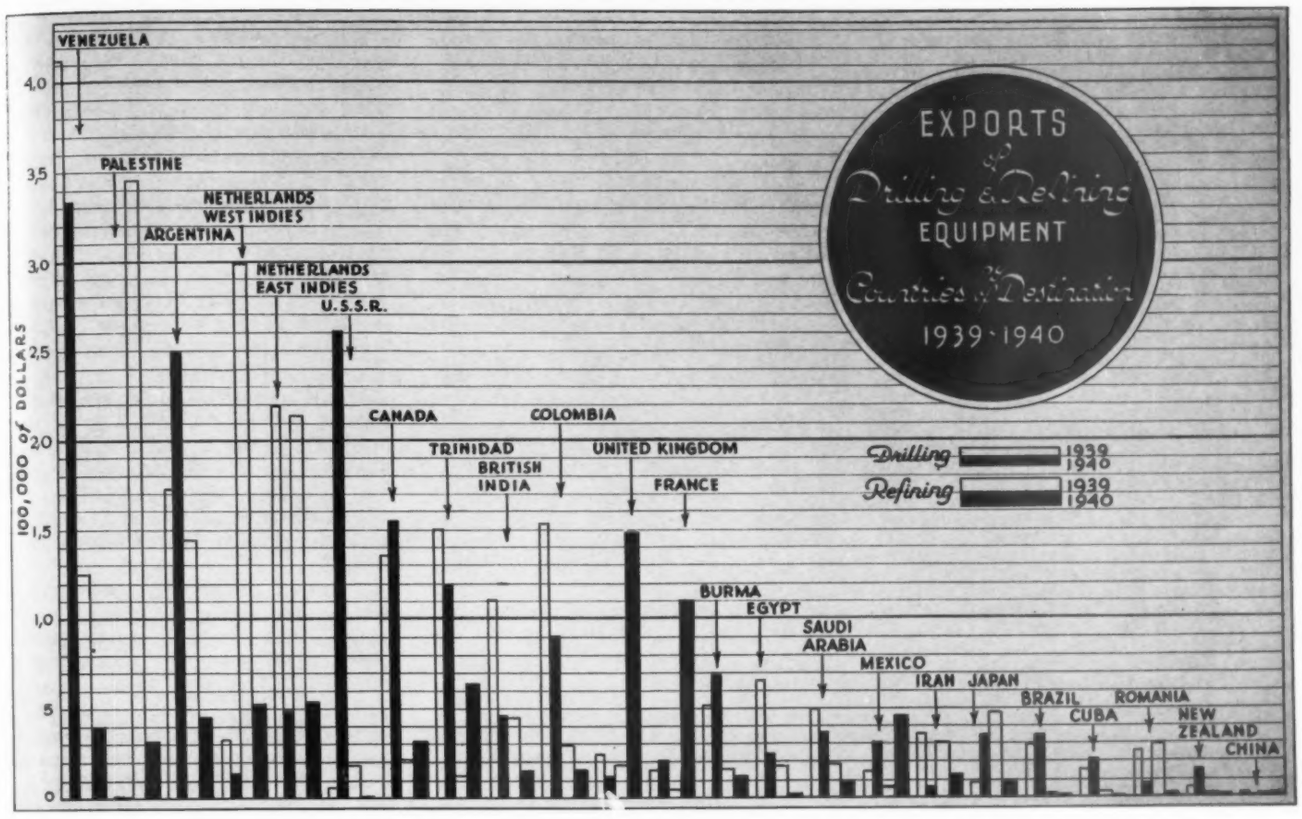
The future trend of petroleum and product exports from the United States will continue to depend on the course taken by the European war. Should it increase in intensity, involving large movements of land and sea forces as well as continued air activity it is likely that United States exports may show some improvement although hardly to the point that they enjoyed before the war. This trend would assuredly be accentuated should developments occur to make it more difficult for the British to continue shipments around the Cape of Good Hope and through the Mediterranean. In any event, continuation of present aerial tactics may require increased shipments of aviation gasoline and other refined products if refineries in England and other parts of the British Empire become as important targets for the German airforce as Nazi plants apparently have been for the Royal Air Force.

But one thing is practically certain: on the conclusion of hostilities there will be a great revival of export shipments from the United States and from the principal South American exporting countries. Many of the state subsidized railroads which have proved so vulnerable to bombers may never be rebuilt, and will in many cases be substituted by road borne traffic. Some time must elapse before damaged refinery centers can be rebuilt. The transportation division of the reconstruction effort will undoubtedly depend largely on gasoline and Diesel fuel, and for some years after the cessation of hostilities such supplies may have to come from the United States and South America.

U. S. Exports of Petroleum and Products by Products and by Countries of Destination 1939-1940

Destinations in order of importance		Crude Bbl.	Natural Gasoline Bbl.	Aviation Gasoline Bbl.	Other Gasoline Bbl.	Other Light Products Bbl.	Benzol Bbl.	Mineral Spirits Bbl.	Kerosene Bbl.	Gas Oil and Distillate Bbl.	Residual Fuel Oil Bbl.	Lubricatg Oil Bbl.	Lubricatg Greases Lbs.	Total Liquid Products Bbl.
Canada	1940	28,778,149	1,051,364	123,308	1,203,566	85,472	5,120	9,000	186,251	539,243	1,643,888	546,661	7,783,293	34,172,020
	1939	28,120,634	796,342	194,474	1,758,199	94,859	2,400	1,200	189,168	569,060	610,779	523,800	7,397,861	32,860,915
Japan	1940	11,465,667	5,062	527,451	2,624,342	5,702	7,400	1	43,463	5,116,180	2,132,146	819,414	14,604,630	22,746,728
	1939	16,086,176	181,210	547,343	650,379	2,534	.....	.....	104,501	6,020,182	3,888,754	513,630	12,024,436	27,894,709
United Kingdom	1940	533,126	199,080	845,977	2,345,439	25,547	.....	740	428,442	3,363,814	340,331	3,457,123	7,801,983	11,539,619
	1939	560,297	785,802	491,481	7,562,673	173,542	80,000	800	1,466,894	4,343,832	279,293	2,903,470	9,982,495	18,648,884
France	1940	5,586,558	191,265	513,513	1,137	1	151,300	170	491	.....	.....	330,793	3,406,877	6,775,228
	1939	14,955,208	526,784	645,880	1,358,646	43,633	168,300	60	465	132,854	.....	480,470	4,566,766	18,312,309
Netherlands West Indies	1940	.....	103,851	499,197	274,009	20,227	.....	60	26,089	2,015,289	.....	20,425	114,206	2,959,147
	1939	.....	1,504,211	786,620	2,050,982	686,351	.....	40	560,785	4,843,203	.....	20,363	288,758	10,452,555
Italy	1940	1,420,253	19,455	.....	55,243	120	14,000	.....	3	172,622	129,793	317,488	1,375,199	2,128,977
	1939	4,984,829	101,324	213,927	4,773	.....	.....	.....	13,793	150,831	1,402,017	483,471	674,599	7,354,965
Cuba	1940	822,137	.....	27,906	501,527	67	3,200	60	136	50	566,052	39,813	1,743,783	1,960,957
	1939	1,140,859	.....	19,133	511,085	120	3,400	30	1,172	67,595	322,362	55,338	2,571,752	2,121,094
Australia	1940	8,745	.....	1,311	928,949	33,079	.....	10,600	154,130	62,375	7,249	626,603	4,226,895	1,832,132
	1939	.....	.....	3,080	734,095	18,828	.....	41,200	107,734	35,122	.....	600,282	5,963,034	1,540,341
Brazil	1940	249,567	.....	37,961	755,938	6,755	600	9,070	227,173	161,234	.....	313,420	2,360,283	1,781,718
	1939	172,745	.....	25,313	1,246,256	7,183	800	17,800	413,372	179,931	.....	301,042	2,754,714	2,364,442
China	1940	.....	.....	1,209	319,461	1,338	500	400	332,088	225,088	61,739	204,087	4,135,487	1,145,910
	1939	88,962	.....	.....	149,199	622	1,800	200	231,302	341,307	221,674	124,599	1,497,204	1,159,665
U. S. S. R.	1940	.....	.....	.....	1,065,421	.....	.....	.....	.....	65,285	.....	29	13,440	1,130,735
	1939	.....	.....	2	883,530	.....	.....	.....	.....	.....	.....	2	68,439	883,534
Argentina	1940	779,070	.....	.....	.....	1,134	1,800	400	708	158	.....	46,965	109,339	830,225
	1939	2,124,955	.....	409	79	350	4,400	800	157	.....	.....	22,565	282,516	2,153,715
New Zealand	1940	200	.....	313	3,722	9,596	.....	3,500	6,755	48,605	100,828	161,311	1,646,211	335,024
	1939	.....	91,359	79,871	210,799	2,742	400	5,100	29,214	49,654	89,435	106,228	1,283,365	666,802
World*	1940	51,599,402	1,707,093	2,992,457	16,542,718	229,268	189,000	62,000	3,138,822	17,596,828	11,847,631	10,362,563	99,758,014	116,267,787
	1939	72,063,824	4,110,896	3,983,728	32,504,970	1,443,550	322,000	121,000	7,994,223	30,664,514	14,925,828	11,864,943	108,561,007	180,009,476

Figures from U. S. Department of Commerce.
*Includes countries not shown in above compilation.



Oil Equipment Exports Require Licenses According to February Proclamation

While Total Value of Drilling and Refining Equipment Exports from The United States Declined 32 Percent Russia Increased Purchases in U.S. by 960 Percent—Mainly Portable Equipment that Might Enter Soviet-German Trade Agreement.

A COMPARISON of the value of petroleum equipment exports from the United States for the past year against 1939 shows wide and violent fluctuations, but the outstanding feature is an increase of 959.75 percent in shipments to Russia. Total value of such shipments is given as $2,606,583 in 1940 against $245,797 in 1939, thus making the Soviet Union the third largest purchaser of United States petroleum equipment, outranked only by Venezuela and Argentina. A second important feature of the recently released Department of Commerce figures is the abrupt increase in value of equipment shipments to Japan. While for the entire year Japan took 4.09 percent less equipment from the United States there was a marked upturn in the month of December when drilling equipment alone, valued at $281,437 was shipped to Japan, considerably more than that country had imported in the preceding 11 months.

No doubt these increases were largely

Comparative Value of U. S. Drilling and Refining Equipment Exports 1939-1940
(By Principal Countries)

Destination in order of importance	Drilling Equipment (Value in Dollars) 1940	1939	Refining Equipment (Value in Dollars) 1940	1939	Total (Value in Dollars) 1940	1939
Venezuela	3,315,299	4,127,265	393,128	1,255,596	3,713,427	5,382,861
Argentina	2,499,422	1,737,444	459,366	1,445,986	2,958,788	3,183,430
U. S. S. R.	2,605,313	65,751	1,270	180,046	2,606,583	245,797
Canada	1,550,346	1,358,387	312,197	211,061	1,862,743	1,569,450
Trinidad	1,191,480	1,507,009	643,228	130,775	1,834,708	1,637,784
United Kingdom	121,359	239,371	1,485,371	180,828	1,606,730	420,199
France	203,021	159,641	1,103,561	48,140	1,306,582	207,781
Colombia	900,211	1,534,610	165,252	294,315	1,065,463	1,828,925
Netherland India	179,415	2,198,651	535,312	2,147,096	1,014,727	4,345,747
Burma	693,700	511,116	122,628	165,421	816,328	676,537
Mexico	308,050	145,735	456,107	67,542	764,157	213,277
Netherland West Indies	138,679	323,866	523,882	2,949,772	662,561	3,273,638
British India	454,811	1,117,795	148,267	446,525	603,078	1,564,320
Saudi Arabia	362,593	497,275	90,730	186,966	453,323	684,241
Japan	348,894*	86,027	96,435	378,062	445,329	464,089
Brazil	343,233	292,195	13,116	17,064	256,349	309,259
Egypt	241,148	658,262	20,024	171,537	261,172	829,799
Palestine	12,395	12,799	209,755	3,457,542	220,150	3,470,341
Cuba	207,530	159,433	6,065	26,621	213,595	186,054
Iran	62,126	357,555	127,433	306,513	189,559	664,068
New Zealand	155,730	57,540	10,941	16,203	166,671	73,743
Roumania	85,028	261,243	15,681	299,267	100,709	560,510
China	4,590	16,261	11,980	7,854	16,570	24,115
World Total*	17,549,729	19,807,424	7,328,206	17,125,601	24,877,935	36,933,025

Figures from The U. S. Department of Commerce.
*Includes exports to countries not shown in the above compilation.

responsible for the presidential proclamation of February 3 which placed oil well drilling and refinery equipment under the export licensing provisions of the Act of July 2, 1940. While this proclamation covered radium, uranium, calf skins and kid skins there was ample reason to believe that the State Department was motivated chiefly by the great increase in Russian purchases of portable drilling equipment. During 1939 Russia took drilling equipment valued at only $65,751 from the United States, while in 1940 Russian purchases of drilling equipment amounted to $2,605,313. Russian purchases of refining equipment in the United States actually declined from a value of $180,046 in 1939 to $1,270 in 1940.

In addition to the value of Soviet purchases already recorded the State Department was aware that representatives of U. S. S. R. were negotiating with United States manufacturers for additional millions of dollars worth of drilling equipment. Manufacturers, according to State Department officials, had already voluntarily offered cooperation in checking such shipments to Russia as soon as they had become aware that the government was concerned lest Russia prove a major breach in the British blockade of Axis powers.

The portable drilling equipment was of high quality and easily transported from field to field. In view of Russia's recent trade agreement with Germany calling for increased shipments of Soviet petroleum and products to Germany, it was felt that such equipment might be used to increase Russian production by 25,000 to 30,000 bbl. per day, of which the equipment was easily capable, for additional shipments to Germany; or the portable drilling rigs themselves might be used in Poland for the benefit of Germany.

Analysis of the accompanying table of value of drilling and refining equipment exported from the United States during 1940 as compared with the preceding year reveals that logical and important markets declined substantially: thus, Venezuelan purchases declined by 31.21 percent, Argentine purchases declined by 7.04 percent, Colombian purchases in the United States were off 41.77 percent and shipments to Netherland India dropped in value by 76.64 percent. The Netherlands West Indies shipments dropped 79.75 percent, exports to British India declined 61.44 percent and those to Saudi Arabia were off by 33.76 percent. Egypt and Iran also showed substantial decreases in value of shipments of equipment from the United States. Roumania of course, was practically cut off from United States shipments, value of which declined 82.00 percent. Palestine also showed a drop of 93.65 percent in value of imports from the United States but the significance of this drop probably lies in a single construction job; practically the entire decrease occurred in value of refining equipment and merely marked the completion of purchases for the refinery built at Haifa at one terminus of the Iraq pipeline. Normally, except for specific jobs of this kind, Palestine is not a big purchaser of United States equipment.

British Empire purchases of American drilling and refining equipment showed e considerable increase, United Kingdom purchases being up 282.62 percent in 1940 compared with 1939, Canadian purchases having increased by 18.75 percent in the same period and shipments to Trinidad having increased by 12.03 percent. At the same time New Zealand took 125.67 percent more and Burma took 20.53 percent more United States equipment. French purchases of United States refining equipment shot up by 528.36 percent in 1940 over 1939 although shipments were confined entirely to the first half of the year.

The only other outstanding change of the past year was an increase of 211.73 percent in the value of drilling equipment shipped to Mexico from the United States. Mexico is apparently relying largely on United States manufacturers to make a success of government operation of the expropriated oilfields.

Japanese imports of United States drilling equipment present a curious picture. During 1939, Japan imported $86,027 worth of such machinery: during the first 11 months of 1940 value of drilling rigs and parts shipped to Japan remained consistent with the preceding year's picture amounting to but $67,457. Then in December 1940 Japanese purchases in the United States shot up to a total for the month of $281,437 suggesting the possibility that Japan may have been purchasing for the account of another country that could not or did not wish to purchase direct from the United States. Japan's moderate production and limited drilling campaign would hardly warrant such purchases for her own use.

DEFENSE REQUIREMENTS of Residual Fuel Oil Will Not Cause Excessive Runs to Stills

Adequate Supply for Essential Uses Assured Despite Decreasing Yield of Residual Fuel Oil.

THE PRODUCTS derived from petroleum are many and their uses are varied. To list all of them would be a considerable undertaking, particularly as the list grows longer day by day. For several years past, however, the principal products have been gasoline for use in internal combustion motors, kerosene for domestic heating, and, to a considerably lesser extent than heretofore, for lighting; distillate fuel oil used principaIly for heating and as Diesel fuel; lubricants to oil the wheels of industry; residual fuel oil used as a fuel in heavy industry—the railroads, shipping, the oil industry itself, etc., and the solid products wax, asphalt and coke. Strangely enough over the years the supply of these products has been kept in reasonable balance with the demand. At times disequilibrium has occurred and voluntary effort on the part of the industry has been required to restore a balanced condition, but, on the whole, prices operating in a free economy seem to have kept the relative outputs reasonably well balanced.

In discussions of the economics of this amazing industry over the last thirty years, gasoline, as the major product, has received the greatest consideration. In more recent years the widespread use of distillate fuel oil for domestic heating has forced upon the industry the necessity of supplying two "major products" from the same crude. These twins which are taken simultaneously out of the same crude, have proved at times a troublesome pair, as the peak consumption of each occurs during the period of the lowest consumption of the other. However, by judiciously accumulating one while the other is being consumed, the two demands—entirely unrelated one to the other—have been met.

Over the last 40 years at least residual fuel oil has accounted for a substantial percentage of the total output of refined products. Originally produced as an unwanted by-product, dumped on the market and destined to be booted around down through the years, it nevertheless has had an important effect on the general economy of the industry. It is of great importance today because of the possibility of a substantial increase in consumption of the product by the Navy and by industries engaged in the manufacture of defense materials where residual fuel oil has a decided advantage over other forms of fuel. Consequently, it is in order to give some thought to what might happen should such an increase develop.

The question has both near term and long term aspects. As to the latter it is reasonable to assume that the yield of residual fuel oil

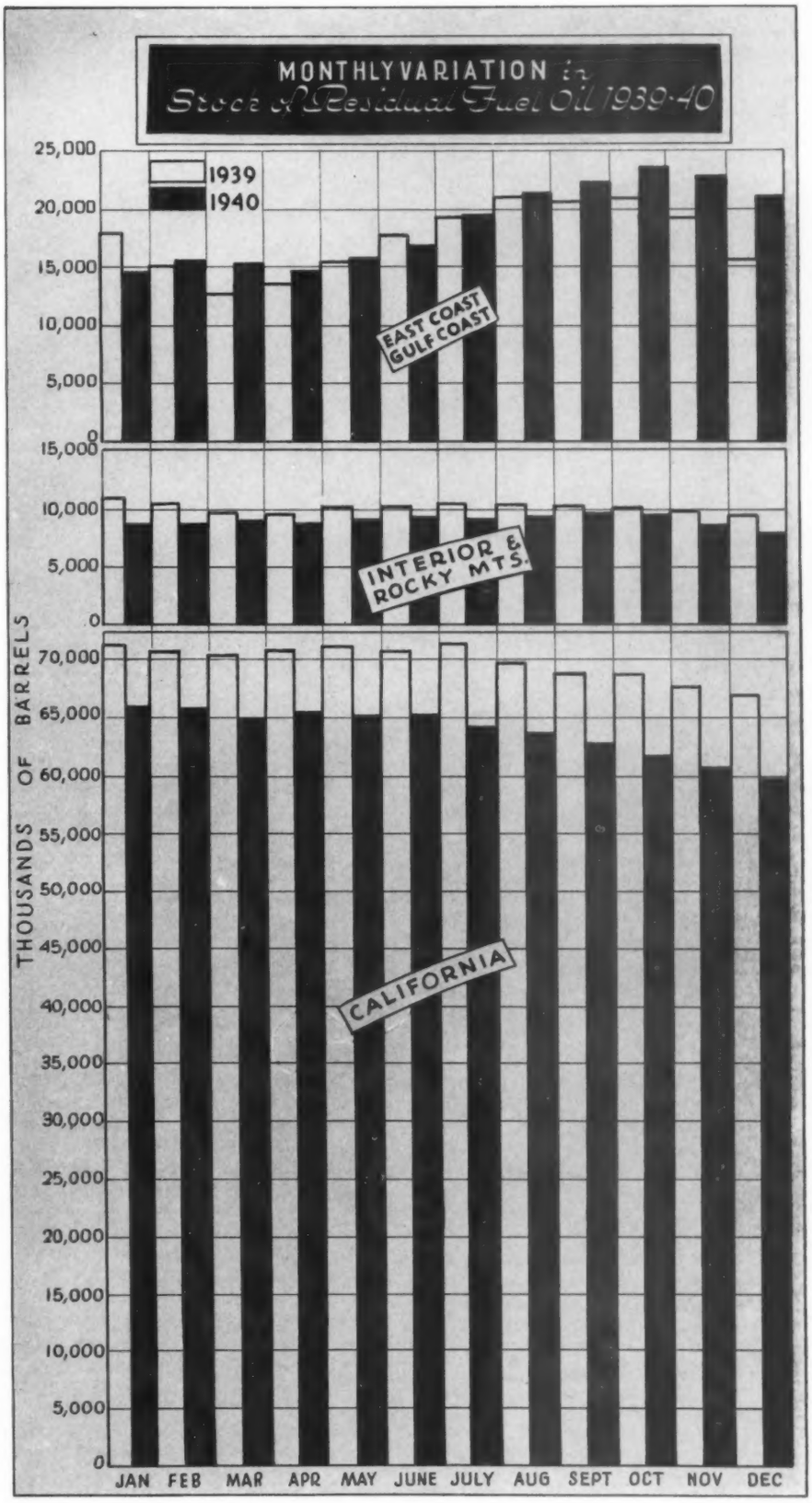
from crude oil will continue to decline as it has over the last 25 years so that regardless of increases that might be expected in the amount of crude refined to meet the major products, no great increase can be expected in the amount of residual fuel oil available. We might inquire, therefore, as to just what the industry's attitude will be toward the additional demand.

Stocks of the product on the East Coast and Gulf Coast on December 31st were adequate and actually about 5.5 million bbl. higher than a year ago. In other refining districts east of California they were about 1.5 million bbl. less than a year ago. In total, East of California there was an increase in stocks of 4 million bbl. As the domestic demand East of California during 1940 was about 253 million bbl., these additional stocks would supply less than a two percent increase in demand. Among the other ways of meeting the increase in demand might be listed the following:

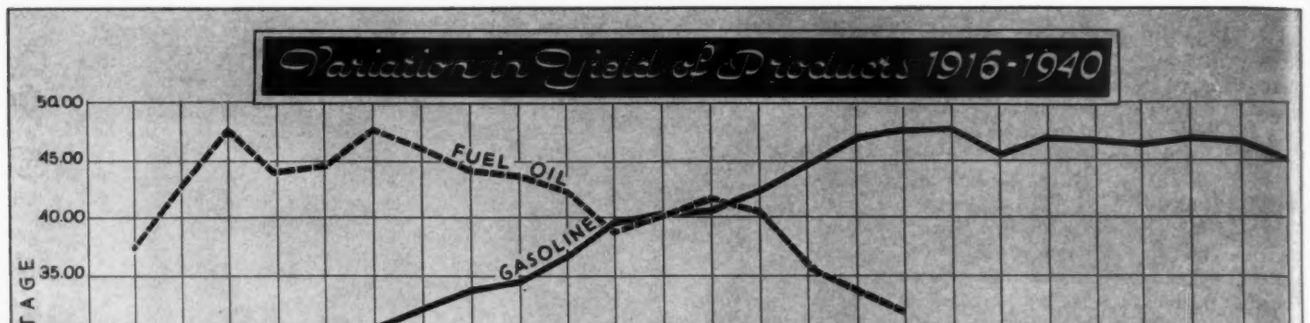
1. Increasing the output of the product by refining more crude oil.
2. Increasing the yield of the product from crude oil.
3. Varying the relative production of high gravity and low gravity crudes.
4. Moving it from California where a surplus exists to the East Coast.
5. Importing additional supplies.
6. Restricting the use of fuel oil to only those usees for which other fuels cannot be substituted.

Before examining any of these possibilities, it is worthwhile to see how the increase in demand has been met in the past. In looking over the history of the product, the years up to about 1900 can be ignored. During that time most of the crude oil produced in the United States came from the Appalachian region and was refined almost entirely into gasoline, which was not wanted, kerosene, lubricants and wax. From 1900 to date, the history falls rather naturally into three periods or time divisions, the boundaries of which have not been sharp or distinct. The first period comprises the years 1900 to approximately 1915, during which the production from fields in the Southwest and California increased rapidly. This first period closes with the acceptance of the cracking process of refining. The next period is that in which more and more fuel oil was used in cracking stills and ends sometime in the 30's, when practically all fuel oil was cracked to some extent. The third period extends up to the present.

Beginning about the turn of the century when mechanical industrialization of the nation was going forward rapidly, the increasing consumption of gasoline and lubricants could be met only by refining additional quantities of crude oil. The discovery and development of the fields in southwestern states and in California after 1900 resulted in the manufacture of a large supply of residual fuel oil for, with the refining processes existing prior to about 1915, the greater part of the residuum left after distilling off the gasoline and kerosene by straight-run methods was sold as fuel oil. To the extent for which there was a market, some of the residuum was further refined into lubricants, wax, road oil and asphalt.



In this first phase of residual fuel oil history, gasoline consumption was growing by leaps and bounds and could be met only



by refining additional crude oil. The fuel oil had to find a market and mechanical industries which were being created were willing to buy it but only on a strictly heat content basis. Fuel oil, consequently, had to be sold in competition with coal with little, if any, consideration being given to its advantages as a liquid fuel. The exception to this was the widespread use of fuel oil by railroads in the Southwest and in California where it would have been prohibitively costly to drop supplies of coal along the route of the railways particularly those traversing vast stretches of unsettled land. Along with this use of the product by the railroads other industries soon recognized the advantages of the liquid fuel and beginning about 1910 Mexican oil was imported into the United States for use principally as fuel. This import movement increased year by year on into the second period of the history.

The second phase in the history of the product began with the acceptance of cracking as a refining method sometime about 1915. After the potentialities of residuum as a source of gasoline had been recognized there was an ever increasing use of residual fuel oil as a charging stock to cracking plants and the end of the second period occurred some time in the 30's when straight run residual fuel oil practically ceased to be marketed east of California. During this second period the increase in the demand for gasoline continued to require greater and greater amounts of crude oil and, as mentioned, imports from Mexico continued to increase. During the year 1921 imports into the United States were equal to more than 26 percent of the domestic production. Late in 1922 the supply was further augmented substantially by shipments of California crude through the Panama Canal following the discovery of the prolific fields in the Los Angeles Basin, the oil from which contains a large percentage of residual fuel. At about the same time the great Smackover Field was discovered and much of its low gravity production was burned as fuel oil.

It might be well to note at this point that except for the years 1922 to 1926, California supplies of crude oil and residual fuel oil have had little effect on the industry east of California and in any discussion of residual fuel oil the two areas, namely, Pacific Coast states and East of California might better be thought of as separate and distinct provinces. There has been some eastward movement of California residual fuel oil in recent years, but in spite of the tremendous surplus of the product in California, shipments in each of the last six years have amounted to less than one million barrels a year. Of vastly more importance has been the effect of the world-wide market on both of these provinces. In California, today, the stocks of residual fuel oil and non-gasoline bearing crude oil suitable for use as fuel oil amount to more than 70

Distribution Of Use Of Residual Fuel Oil

		1936 (a) 1000 Bbls.	1937 1000 Bbls.	1938 1000 Bbls.	1939 1000 Bbls.	1939 Percent Total	1940 (a) 1000 Bbls.
East of California	Heating #5 and #6	25,031	29,525	31,157	34,502	14.22	40,000
	Railroads	35,500	38,605	32,439	35,669	14.70	36,000
	Vessels	47,300	52,120	46,230	47,191	19.44	46,000
	Gas and Elec. Power Plants	2 ,500	19,914	21,118	25,611	10.55	27,000
	Other Industries	55,200	57,640	46,787	51,253	21.12	55,000
	Navy, Army and C. G.	2,500	3,177	4,563	5,507	2.27	6,000
	Oil Company Fuel	40,900	36,573	36,384	38,190	15.73	38,000
	Miscellaneous Uses	2,300	3,784	3,176	3,646	1.50	4,722
	Unaccounted for	*4,890*	*6,543*	1,385	1,143	.47	
	Total	225,341	234,795	223,239	242,712	100.00	252,722
Pacific Coast Territory	Heating #5 and #6	4,367	5,857	4,778	4,599	5.97	4,500
	Railroads	24,800	29,224	23,670	25,308	32.85	28,500
	Vessels	19,700	19,376	14,948	17,955	23.31	20,000
	Gas and Electric Power Plants	2,000	3,607	2,764	2,297	2.98	2,500
	Other Industries	10,200	11,467	8,027	9,598	12.46	11,000
	Navy, Army and C. G.	6,500	5,615	6,411	5,652	7.34	6,000
	Oil Company Fuel	4,100	3,622	4,130	7,833	10.17	8,000
	Miscellaneous Uses	4,000	3,127	1,763	1,344	1.74	2,433
	Unacct'd. for and Diesel Fuel	6,876	8,824	2,103	2,440	3.18	
	Total	82,543	90,719	68,594	77,026	100.00	82,933
United States	Heating #5 and #6	29,398	35,382	35,935	39,101	12.22	44,500
	Railroads	60,300	67,829	56,109	60,977	19.07	64,500
	Vessels	67,000	71,496	61,178	65,146	20.37	66,000
	Gas and Electric Power Plants	23,500	23,521	23,882	27,908	8.73	29,500
	Other Industries	65,400	69,107	54,814	60,851	19.03	66,000
	Navy, Army and C. G.	9,000	8,792	10,974	11,159	3.49	12,000
	Oil Company Fuel	45,000	40,195	40,514	46,023	14.39	46,000
	Miscellaneous Uses	6,300	6,911	4,979	4,990	1.56	7,155
	Unaccounted for	1,986	2,281	3,488	3,583	1.14	
	Total	307,884	325,514	291,833	319,738	100.00	335,655

Source: Bureau of Mines except as noted.
(a) Estimates by Author.

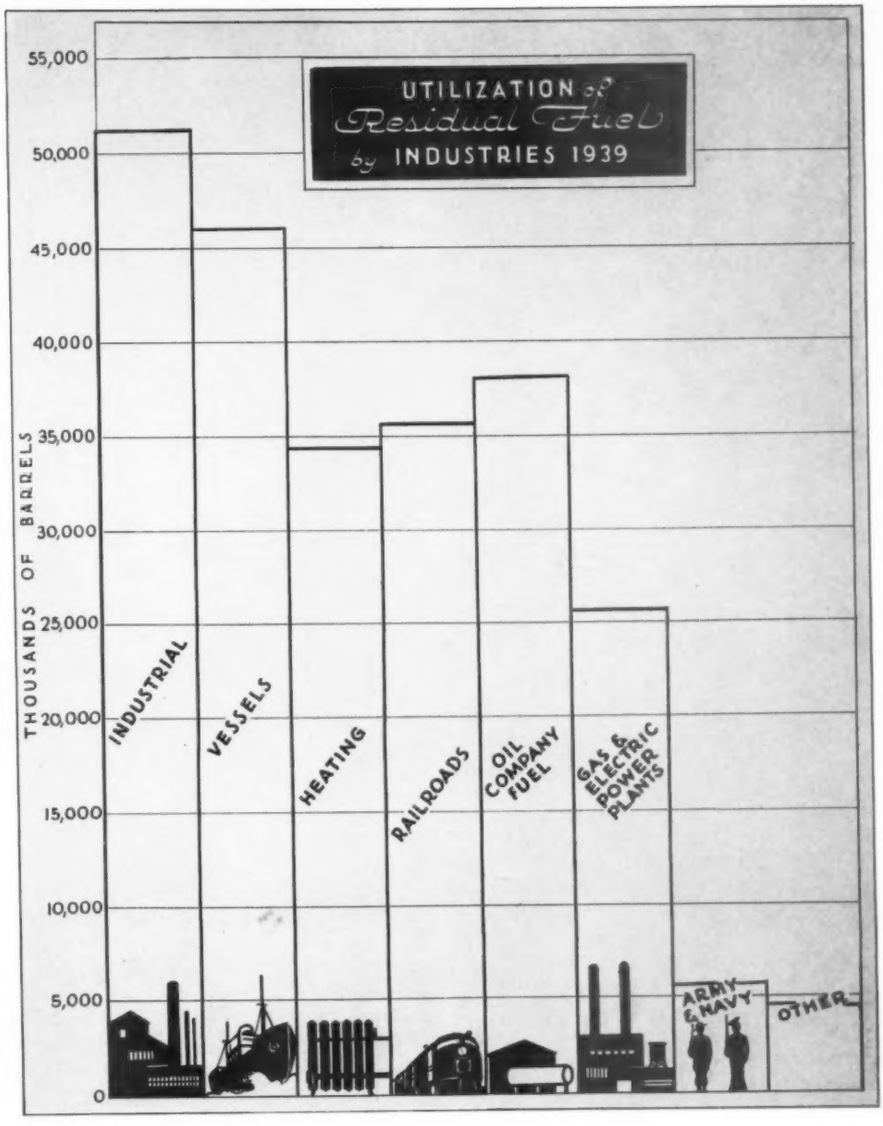
million bbl. and there is no problem whatever in meeting any conceivable increase in demand. The remainder of the discussion, therefore, will be confined to that part of the United States east of California.

Although separate figures for distillate and residual fuel oil are not available prior to 1930, the combined statistics prior to that date indicate that the demand for residual fuel oil increased steadily up to the year 1929 and this in face of a declining percentage yield from crude. During the depression years 1930 to 1933 the trend of demand was downward but with the recovery it turned upward again in 1934 to 1937. 1938 again saw a reversal but increases in 1939 and 1940 brought the domestic demand for the product to an all-time high of approximately 252.7 million bbl. east of California. (335.6 million bbl. for the U. S.) The increase in demand from 1930 to 1940 like the increase prior to 1930 has been accompanied by a constantly declining percentage yield from crude.

Chart (p.34) shows the relationship between the total demand, domestic and export, for residual fuel oil east of California and the yield from crude. Also shown are the runs to stills and the refinery production of the product.

Chart (p.32) shows the yields of the principal products obtained from crude oil during the years 1916 to 1940 inclusive; the second and third periods in the product's history. Yields of all fuel oils—distillate and residual—decreased from 47.6 percent in 1918 to 35.7 percent in 1930. The reduction in the yield of residual fuel oil was more pronounced than is indicated by these figures because of the increase in distillate fuel oil that must have occurred during this period. Although statistics are not available on the output of distillate fuel oil in 1918 it is known that its use was limited and it probably is fair to say that the yield of residual fuel oil decreased from approximately 45 percent in 1918 to the statistically recorded 27.3 percent in 1930. The yield continued to decline to 21.2 percent in 1940—less than half the 1918 percentage yield.

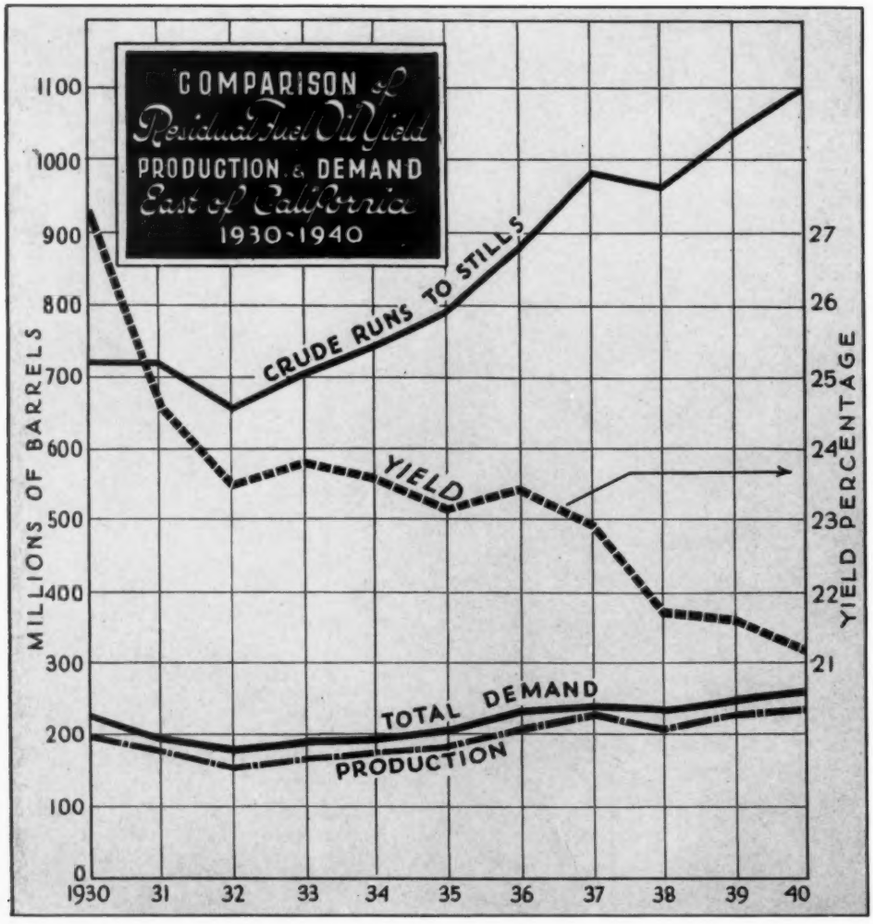
In the third or present-day phase of the product, the use of residual fuel oil can be thought of as being composed of two parts—the one flexible, that is, susceptible of being replaced by substitute fuels and the other inflexible, that is, not readily susceptible to replacement. Among the inflexible consumers are most of the railroads now using the fuel, to some extent the oil companies themselves and a part of those who use the product for heating. The use of the fuel in ships is, of course, most inflexible but those engaged in international trade can buy elsewhere than in the United States if the price at another port of call is more attractive. The flexible users are the gas and electric power plants and most industries. The above chart and the table on page 32 show the distribution of the use of residual fuel oil. The above chart (for the year 1939 east of California only). For the year 1939 (the last year for which actual figures have been published) the use in ships accounted for over 19 percent of the total consumption.



The railroads used 14.7 percent of the total: 14.2 percent was used for heating. Industries, other than railroads, gas and electric power plants, used 21 percent and the oil industry itself was one of its own good customers and used 15.7 percent of the total. The inflexible use of the fuel would appear, therefore, to include much of the 19.4 percent used by ships, the greater part of the 14.7 percent used by the railroads, some portion, perhaps half of the amount used for heating and the larger proportion of the amount used in the oil industry or roughly about 50 percent of the total. Thus, the flexible use is about equal to the inflexible use.

The inflexible use of the product is related very closely to general industrial conditions. The flexible use is related almost entirely to price and is in fact more sensitive to the effect of price than are any of the other principal petroleum products. Thus, there was a reduction in the use of fuel oil by railroads and ships in 1938 as compared to 1937 paralleling the decline in business activity. The gas and electric power plants, however, used less in 1937 than in 1936 but increased their use in 1938. Their reduced consumption in 1937 was doubtless the result of the high prices which existed in that year and ran counter to trend of industrial production.

The question of proper and improper uses or, as sometimes disguised, superior and inferior uses of residual fuel oil has been raised on many occasions in recent years. It is rather difficult to define a proper or superior use of the product. In the light of present-day conditions, the use of uncracked residuum and of vast quantities of refinable crude oil such as were burned in the years 1900 to 1915, would doubtless be considered improper; but conditions which existed at that time put an entirely different aspect on the practice. The manufacture and sale of cracked residuum today is purely a question of refining economics. A refiner might be equipped to crack his light oils to gasoline and heavy fuel oil or to run to coke but if the final stages of cracking cost more than the value of the products



which he recovers, he will sell his residuum as fuel oil.

It is not the present purpose to unearth an old bone of contention as to proper or superior and improper or inferior uses. It seems of much greater importance that about half the demand can be filled by substitute fuels and that this half will switch to other fuels whenever the equivalent heat content can be obtained from them at lower cost. It must also be borne in mind that the price of crude oil acts as a ceiling for the price of residual fuel oil and that crude prices do affect the demand for residual fuel oil.

It has been pointed out that over the years, in spite of the increasing demand for residual fuel oil the industry continuously has reduced the percentage yield from crude oil and has met the mounting demand by other means—imports, shipments from California and the use of low grade crude oil. The statistics of the industry do not yield any evidence that the industry as a whole has ever sought to increase its output of residual fuel oil by refining additional quantities of crude oil. It is understandable that in isolated instances some refiner having an order for heavy fuel oil for which he would not have the necessary supplies, might have stepped up his runs temporarily knowing that he would have a market for the other products but such a practice has never prevailed throughout the industry. Rather the attitude seems to have been that the industry would supply whatever quantities of heavy fuel oil it found necessary to make in supplying the markets for gasoline, kerosene and distillate fuels and that any demand for the product beyond that would have to be filled from supplies obtained from other sources which up to the present have always been available. This attitude on the part of the industry coupled with the flexibility of half the demand, the ever present alternative of importing supplementary supplies and the normal functioning of price has operated to keep demand and supply in balance. In other words, demand for residual fuel oil has not functioned in the determination of the required runs of crude to stills nor in the demand for crude oil. From the standpoints of industry economics, social economics and conservation of our petroleum resources it is proper that it should not. So long as runs to stills are regulated to meet the demand for gasoline and distillate fuel oil, with equilibrium between these products maintained by regulating the yields and accumulation of stocks in the off season, the respective demands for these essential products, for which there is no acceptable substitute, can be met from a predetermined quantity of crude oil. But were the industry to attempt to bring into the determination of the required runs to stills such a nebulous factor as that of supplying a by-product to be used in destructive price competition with other fuels, the supply of the essential products would greatly exceed the demand, our valuable reserves of petroleum would be depleted needlessly and chaotic conditions doubtless would result. The oil industry has never done this.

Of the six methods suggested earlier for balancing supply and demand it thus appears that the first two namely (1) increasing the output of residual fuel oil by refining more crude and (2) increasing the yield, are contrary to the progressive principles which the industry has followed over the years.

The third proposal, namely that of varying the production of high gravity and low gravity crudes seasonally has many merits. However, the seasonal change in the relative quantities to be produced from the wells can be obviated by storing the low gravity crude in the summer for use in the winter and vice versa for the high gravity. Insofar as the balance between gasoline and distillate fuel oil is concerned, the industry has solved the problem by seasonal variation in yields and accumulation of adequate stocks. The proposal has found its greatest objection in the inequities that would result in the administration of proration. In any event inasmuch as the seasonal variation in production is actually unnecessary, it seems reasonable to assume that if a greater year round demand for these low gravity crudes did actually exist, it would be reflected in today's proration schedules.

The possibility of moving residual fuel oil from California depends, of course, entirely on tanker rates, the availability of boats and the price to be realized in the eastern market. With tanker rates as they are today such a movement is unprofitable as it amounts to nearly two and a half times the cost of bringing supplies from the Gulf Coast or from the refineries in the Carribean. The cost of moving supplies from these latter refineries to the eastern seaboard for use in ships engaged in foreign trade is not prohibitive even with present tanker rates. Such a movement releases for domestic use an equivalent amount of the fuel; it may be expected that it will continue at a high level.

From what has gone before it seems clear that the sixth proposal namely restricting use need never arise. The flexibility of the market and the free functioning of price will assure an adequate supply at a reasonable price to the inflexible consumers.

Oil Equipment for Greek War

ABOUT $1,000,000 worth of oil exploration equipment has been placed at the disposal of the Greek military authorities by William George Helis, Greek oil man from Louisiana, an account of whose activities was published in the February 1940 issue of WORLD PETROLEUM. After a successful career in Louisiana, Mr. Helis became interested in oil exploration in his native counry and was exploring in the Epirus section when war broke out.

NOMADS Meet in New York

Above, H. B. Cheswick pursuing his secretarial duties at the door.

Above, Lloyd G. Ensign (left) and Val R. Wittich.

On Monday, February 3 the New York Chapter of Nomads held their first meeting of the year presided over by the newly elected officers. The meeting, followed by dinner and entertainment was held at the Belmont Plaza and was attended by a large number of guests of the Nomads. Above may be seen John T. Beaumont (left) and R. Palmer (right) of Trinidad Leaseholds conversing with Bill Campbell before dinner. In the lower left hand illustration, Paul Raidorodsky (left) of the Tulsa Nomads is entertained by J. A. Thomas, president of the New York Chapter. In the lower right hand illustration, John Baird, former president of the New York Chapter and now a member of the Board of Regents poses with Walter S. Fellowes, assistant secretary (center) and William Seims, assistant treasurer (right). All the photographs were taken by Robert Yarnall Richie.

Howard Book, sergeant-at-arms, investigates a suspicious implement.

INDUSTRY'S RESEARCH Invaluable to National Defense

For More Than Two Decades Standard Oil Development Has Been Studying, Testing, Developing: Their Work Contributes Enormously to Assurance of a Continuous U. S. Supply of 100-Octane Fuel, Toluol, Synthetic Rubber, Countless Other Vital Supplies in Which U. S. May Be Deficient.

A HEARTENING "Ready for Action" was the oil man's response to the national defense roll call of American industry. Prompting that assured reply were the achievements of organized petroleum research, chemistry and chemical engineering. Supporting it are such organizations as the Standard Oil Development Company.

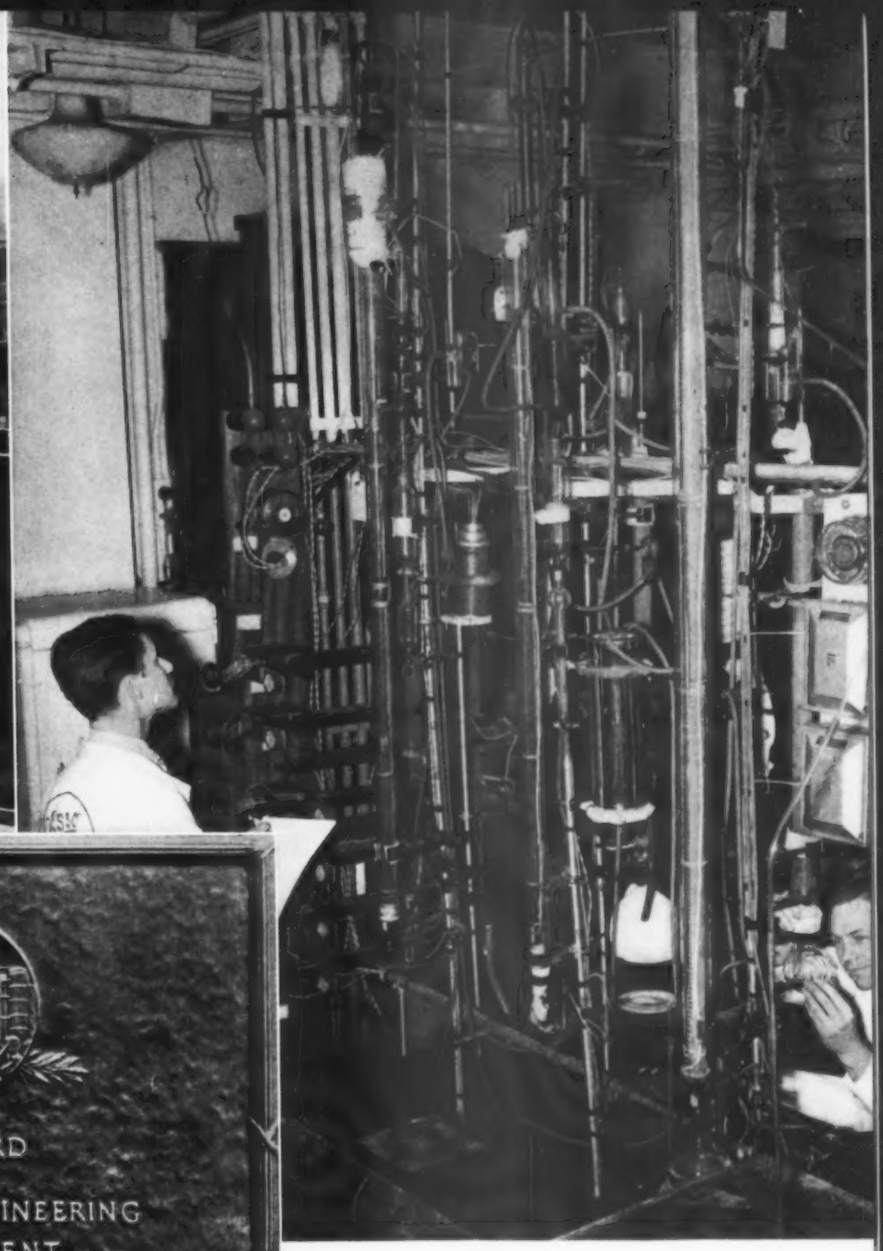
The confidence with which the industry today faces the staggering demands of the defense program is in sharp contrast to the nightmare of supply and transportation problems which gripped America's oil men just twenty-three years ago as World War I roared to a climax. Let us turn back to that picture for a moment.

The winter of 1918 imposed unprecedented burdens upon those responsible for keeping oil pouring into the nation's great war industries, and across the Atlantic to the desperately fighting Allies. There were virtually no stocks of gasoline on hand. Supplies of kerosene and consumer stocks of fuel oil were about normal. But the demand was only starting. From domestic industry and from overseas came the insistent call for more and more fuel. To meet it, refiners had to sacrifice gasoline and kerosene production.

Then a railroad blockade cut supplies of coal, and the natural gas companies were called upon overnight to double their deliveries. At the same time they were besieged with a flood of urgent demands from the army and navy for toluol, a vitally important T. N. T. ingredient. Next, the supply of coal failed completely, and hundreds of consumers turned to gas oil.

To top it all, the terrible winter of 1918 descended in full force, bringing days and nights of almost continuous blizzard and near-zero temperatures. Tank car mileage began to drop. From an average of 25 miles per day, it slowed to 20, 15, and finally to a standstill. Canals and inland waterways were ice-blocked, and water-borne oil cargoes stopped moving. For a brief spell, actual shortage of oil products developed in some districts, but wherever possible the war industries were supplied regardless of expense. It was only by a tremendous effort that the industry managed to break winter's hold and step up production so that within three weeks the wheels were moving again.

Things are different in 1941. Not only is the oil man confident of his ability to meet any demand arising from America's huge rearmament program, but to do it without diverting a single barrel from peacetime consump-



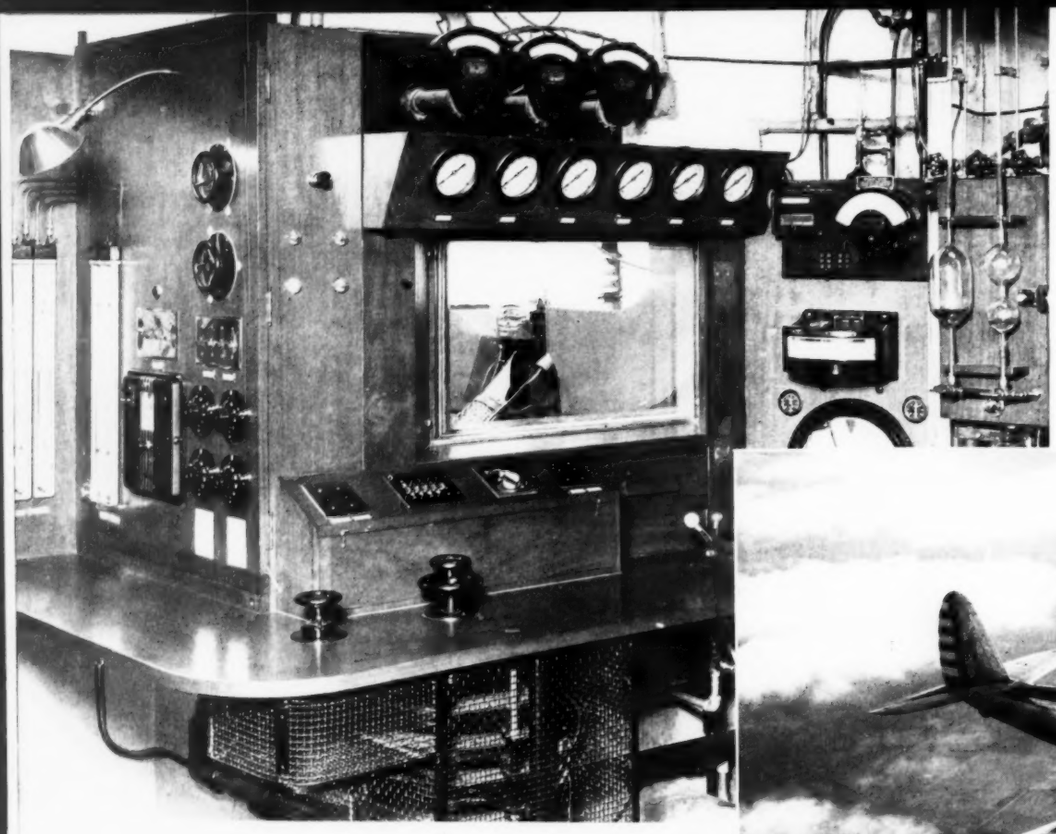
AN AWARD
FOR
CHEMICAL ENGINEERING
ACHIEVEMENT
TO
STANDARD OIL DEVELOPMENT COMPANY
IN RECOGNITION OF ITS MERITORIOUS CONTRIBUTION TO THE ADVANCE OF THE INDUSTRY AND PROFESSION, MADE POSSIBLE THROUGH A BROADER PARTICIPATION BY THE CHEMICAL ENGINEER IN THE AFFAIRS OF THE PROCESS INDUSTRIES
PRESENTED BY
CHEMICAL & METALLURGICAL ENGINEERING
DECEMBER 4, 1939

Above, test car laboratory and a few of the 22 buildings devoted to the research and development activity of Esso Laboratories and Standard Oil Development Company: Extreme right, towers for close cut fractionation in the laboratories of Standard Development: Bottom right, a balance in the analytical laboratories, highly accurate instrument capable of determining weights to an accuracy of 4/100,000,000 of an ounce: Right, the first time the Chemical & Metallurgical award has gone to a research unit in the petroleum industry. Photographs by John Hall for Esso Laboratories.

tion. "Gasoline-less Sundays" have no place in today's refinery schedules.

Last year, with the defense machinery still in low gear and in spite of a heavy drop in exports, the oil industry produced 1,346,000,000 bbl. of crude. Compare that with 1918's record breaking effort of 355,900,000 bbl. In 1940, our refineries processed 1,292,000,000 bbl. of crude without even approaching capacity. In fact, the shutdown capacity of 431,950 bbl. a day is greater than the nation's entire refining output in 1917.

During 1940 the American oil industry produced 557,120,000 bbl. of gasoline, nearly seven times as much as in 1918, and current stocks are sufficient for more than 50 days. Modern technical equipment is available to turn out millions of barrels yearly of the finest 100 octane aviation gasoline in the world. Although that is far greater than the probable demand, it could be doubled with no



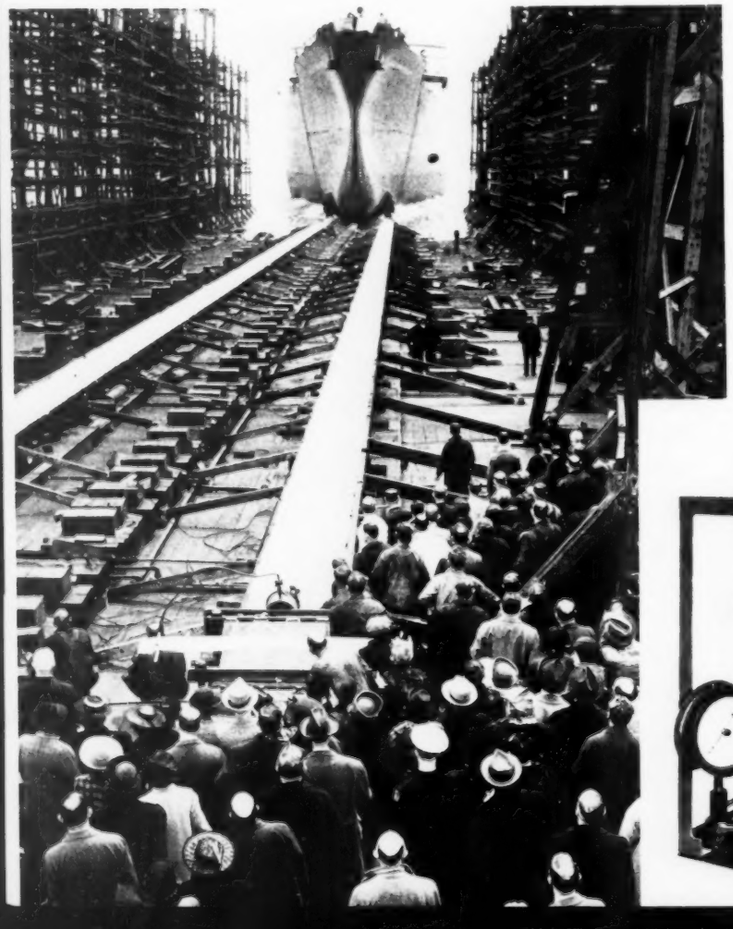
Left. Photo by John Hall for Esso Laboratories.

great effort. In 1918 such super fuels did not exist.

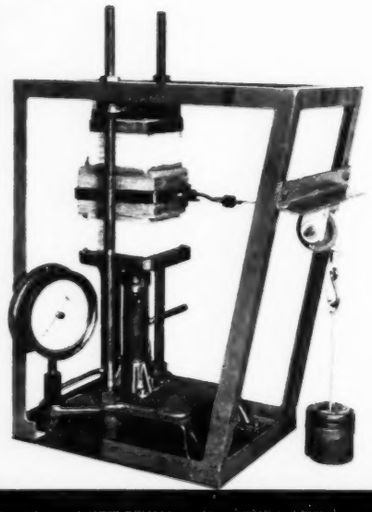
Nor was today's seemingly endless list of petroleum synthetics foreseen at that time. The industry has already begun the commercial production of substitutes for other essentials such as rubber, toluene, glycerin, ammonia and various basic chemicals.

This record of expansion during the past 20-odd years has been made possible by organized research, chemistry and chemical engineering, which in the last eleven years alone has grown 539 percent, according to a recent issue of the American Chemical Society's journal.

Foremost in the ranks of petroleum research organizations is the Standard Oil Development Company. It employs over 600 chemists and engineers, and nearly 1,100 non-technical assistant. Their development of 100 octane aviation fuels, perfection of the hydrogenation process, their work on Buna and Butyl synthetic rubbers, on solvents and on toluol have highlighted a period which witnessed a complete revolution in the business of refining oil.



Top left. A single cylinder, supercharged aircraft engine in a sound-proof, explosion-proof chamber at Esso Laboratories used to test fuels that will later be used in military aircraft. Below, an apparatus for testing launching grease. Behavior of this substance at the time of launching is of the utmost importance. Weights indicate coefficent of friction at pressures shown on the dial at left. Ship is reaching the critical pivoting point when stern floats throwing greatest weight on ways still under the bow.



In 1939, Standard Oil Development Company received the CHEMICAL AND METALLURGICAL ENGINEERING magazine award for "achievement in chemical engineering" and for its work in perfecting super fuels. It was the first time the bronze plaque had been presented to an organization in the petroleum industry.

A subsidiary of Standard Oil Company (N. J.), the S. O. D. is a unique example of an efficient corporate organization based upon cooperative research. It is engaged solely in technical matters pertaining to the oil industry, and carries on its work at three major research and development laboratories —one at Linden, N. J. (Esso Laboratories) another at Baton Rouge, La., and a third in London, England.

Based upon agreements with the principal refining units in the Standard Oil Company (N. J.) group throughout the world, its business is to carry on the major research

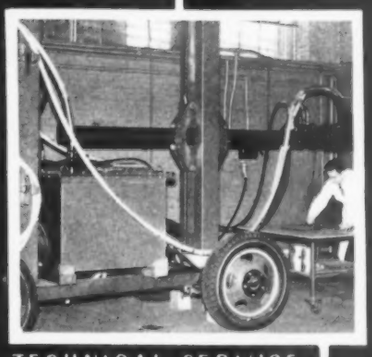
ORGANIZATION CHART of Standard Oil Development Co.

President

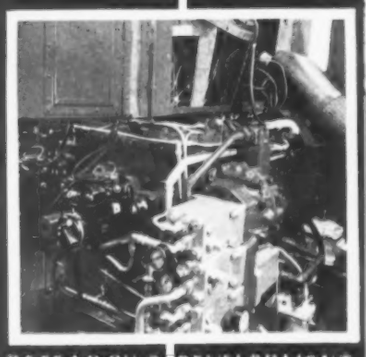
Executive Vice President

PATENT & LEGAL

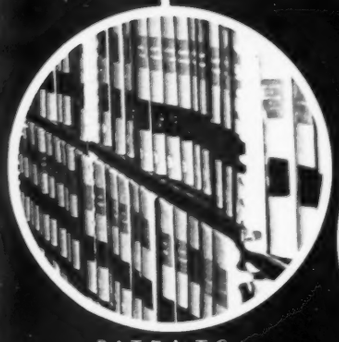
COMMERCIAL



TECHNICAL SERVICE

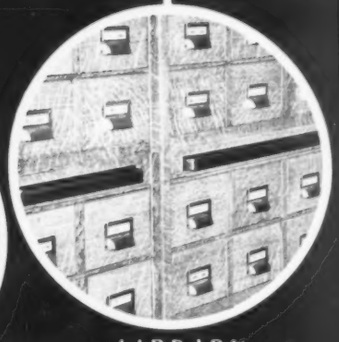


RESEARCH & DEVELOPMENT



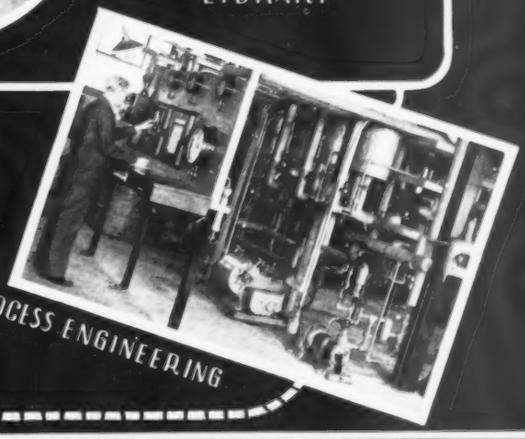
PATENTS

LEGAL

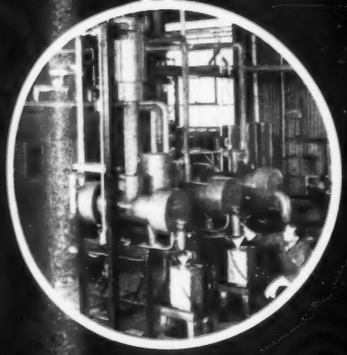


LIBRARY

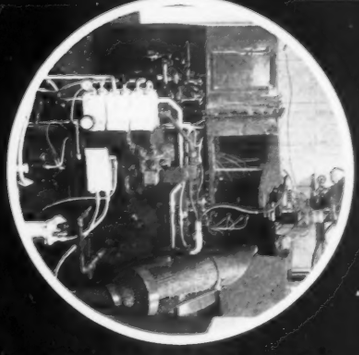
GENERAL ENGINEERING



PROCESS ENGINEERING

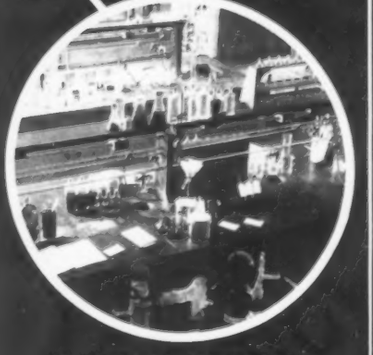


PROCESS DIVISION



DEVELOPMENT DIVISION

RESEARCH DIVISION



CHEMICAL DIVISION

and development activities in which the refineries are interested. Through arrangements with affiliated companies, the S. O. D. indirectly supports and coordinates other large technical facilities and staffs. By eliminating unnecessary duplication of personnel and equipment, and by sharing costs, the company makes possible substantial economies, and permits the organization and maintenance of far more comprehensive research facilities than would have been possible had each refinery unit proceeded independently.

Standard Oil Development's activities, generally speaking, fall into three divisions:

a) improvement of existing products, processes and equipment;
b) expanding product application;
c) discovering new products and develop ing ways and means of producing them commercially.

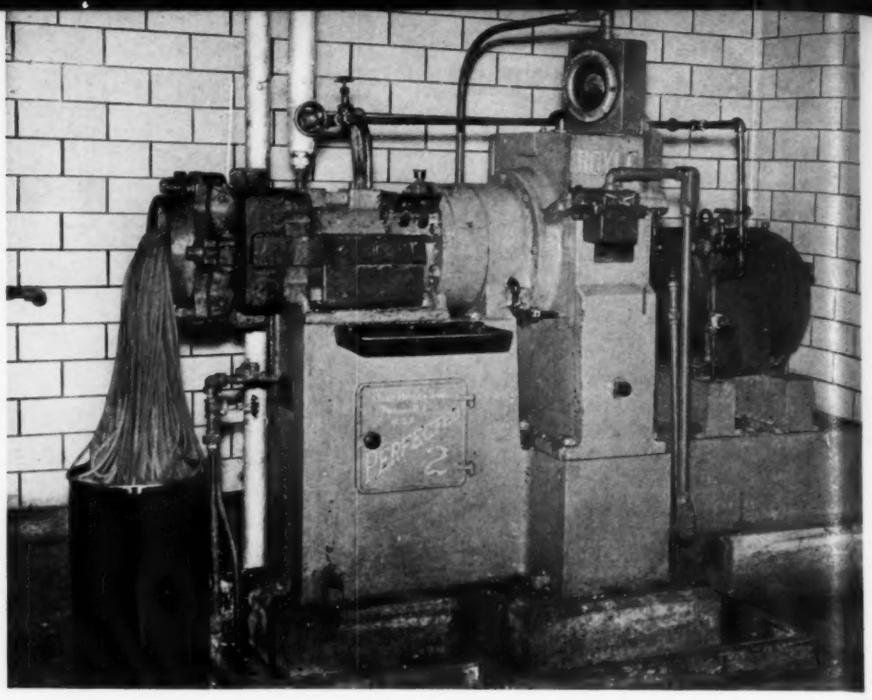
S. O. D. follows a new product from the test tube right through to the retail package. At Linden, N. J. alone the company's facilities include a number of engine laboratories where fuel and lubrication tests are run on automobile, aviation and Diesel engines. To supplement the laboratory findings a fleet of test cars and Esso trucks are used to test fuels and lubricants under actual service conditions.

Standard Inspection Laboratories, another division of S. O. D., keep a constant check on products to make sure they are always up to par. Process engineers build pilot plants to study new developments under conditions simulating full-scale refinery operations. Materials testing laboratories make sure that all equipment and material going into construction is the best suited for the task.

S. O. D. draftsmen may be called upon to draw up blueprints for a new refinery in Venezuela, a bulk plant in Colombia, a marine loading dock at Bayway, N. J. They often supervise the actual construction job, too.

The era which saw the transformation of oil refining and the formation of S. O. D. really began in 1912. Then the few elementary rules of simple distillation, as set forth by Prof. Silliman in 1855, and cracking as originally and accidentally discovered in 1861, still were the accepted refining processes. In 1912, a few venturesome souls tried distilling some of the surplus gas oil under four or five atmospheres of pressure. The equipment held together, they converted some 30 percent into gasoline, and apparently supplied the spark needed to start the inventive genius of the whole industry working.

A year later, at the Whiting refinery, Dr. William M. Burton, president of the Standard Oil Company of Indiana, built the first Burton pressure shell still. Designed solely to crack gas oil and produce gasoline, the new equipment proved popular. But at the Wood River refinery, E. M. Clark was thinking of still further improvements. Coke gathered rapidly in the bottom of the Burton still, forming a layer of insulation that seriously interfered with the transfer of heat from the firebox to the oil. Clark's investigations convinced him that if the oil could be circulated somehow, this accumulation of coke could be retarded.



Last step in the manufacture of Vistanex is this extrusion process carried out at Esso Laboratories. Vistanex, a synthetic rubber substance, is used for insulating trans-Atlantic cables and other similar work.

Thus was evolved the Burton - Clark pressure still in which the oil was circulated through a series of tubes, heat being applied directly to the tubes instead of to the bottom of a still.

Four years later a man named Carleton Ellis, who, until he died recently, had accumulated the third largest number of patents in the history of American invention, discovered a way to make alcohol out of petroleum. In that same year M. D. Mann was helping to build the Seventh Avenue subway in New York City. Inventor Ellis wanted someone to build an alcohol plant, and Engineer Mann promptly abandoned subway construction for a go at chemical engineering.

Before long the new plant appeared at Bayonne, N. J., not far from a large refinery which could supply the necessary raw material, light petroleum naphtha. Moderately successful from the start, the Melco Chemical Company was one of the first affected by America's entrance into the World War. It was taken over by the Bureau of Aircraft Production to make acetones, or solvents used in the manufacture of airplane wing "dope" and smokeless powder.

Despite the turmoil of ensuing months, Mann and a chemist named Robert Williams hit upon the idea of producing isopropyl alcohol by passing cracked refinery gases containing propylene through sulphuric acid, and then washing it with plain water. The idea worked, but as Mann ruefully admitted, "We made about a thimbleful of isopropyl alcohol in two years."

One day, while they were racking their brains in the little wooden shack that served as a laboratory, the engineer and chemist decided to add some gas oil to form an emulsion with the acid. Within half an hour their little lead retort produced more isopropyl alcohol than it had in two years. To transform the alcohol into acetones they simply passed it through a section of hot copper tubing and obtained the amazing yield of 70 percent acetone.

So successful was this process that the government became interested and there was talk in Washington of a $10,000,000 appropriation to build a large plant that would utilize refinery gases commandeered from the large Standard Oil refineries at Bayonne and Bayway. As it turned out the plan was forgotten in the excitement of the Armistice. And when the war stopped so did the business in acetones.

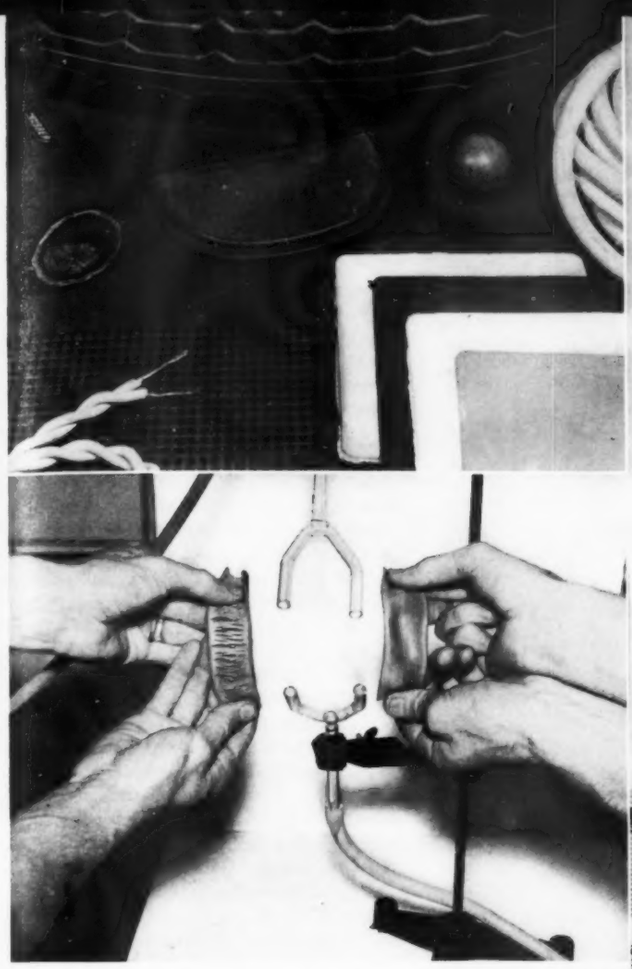
Just about the time that Mann and Williams were trying to sell their process—and themselves—to the oil industry, a group of men were talking near one of the big coking stills at the Bayway Refinery. Raising his voice to be heard above the roar of the furnaces one of them declared, "Our equipment is so good here that it has not been necessary to make a single change since the refinery was built."

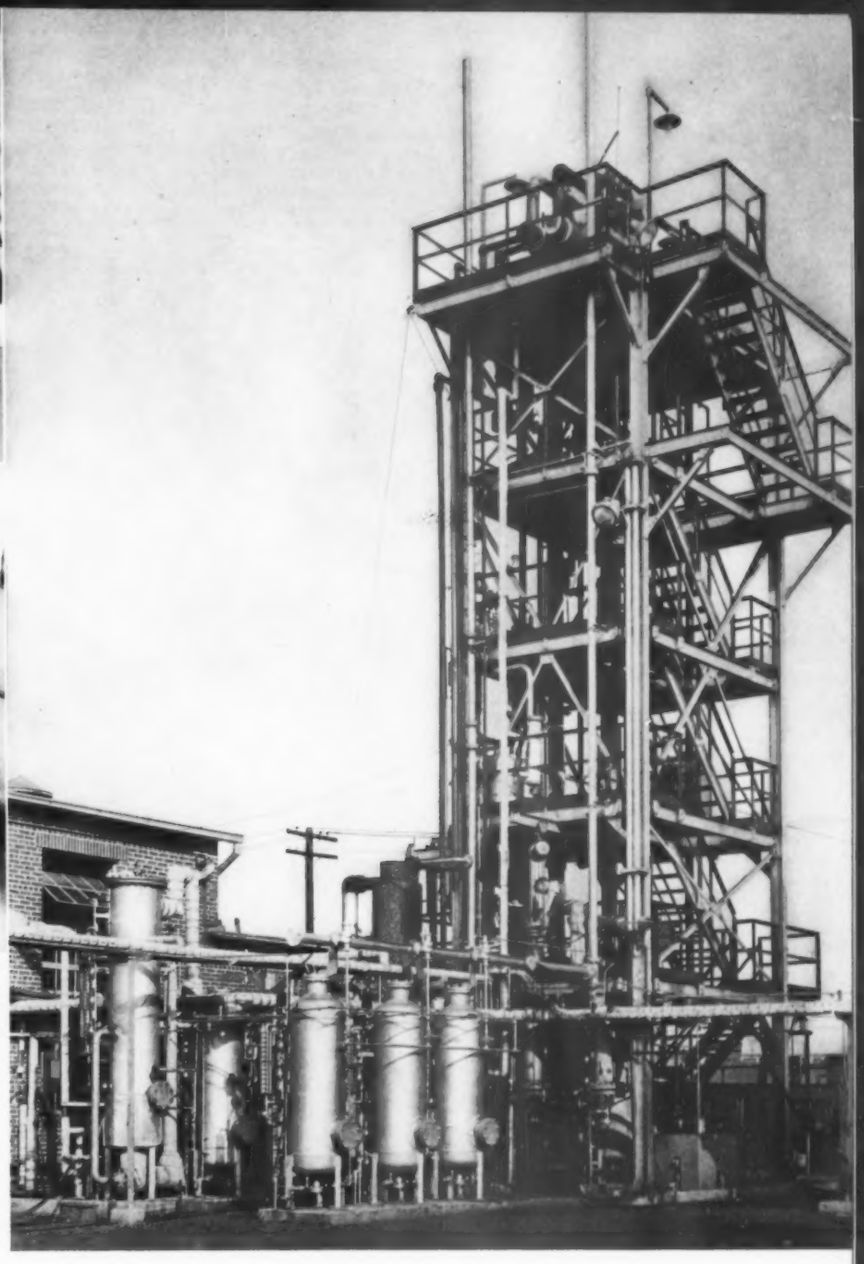
One of the others gazed quizzically at the speaker for a moment, then remarked dryly, "When I can't think of a change to make in our refinery equipment it will be time for me to retire!"

That typical rejoinder came from E. M. Clark, co-inventor of the famous Burton-Clark pressure still, and Bayway's new general manager. Later he was to become president of Standard Oil Development Company and a vice-president and director of the parent company. Ultimately he did retire. But he never lost his capacity for thinking in terms of progress and improvement.

His remark was prophetic of the new philosophy, the new era in oil that was just getting under way. And he was one of the first to recognize the possibilities of putting refinery gases to work.

Mr. Clark asked C. I. Robinson, then chief chemist for Standard Oil, to investigate the process of Mann and Williams. So favorable





Semi-commercial pilot plant for the manufacture of Butyl rubber at Bayway: above, products made from Butyl and comparison of Butyl (right) with natural rubber (left) after exposure to ozone for eight minutes. Photos by John Hall for Esso Laboratories.

was the report that negotiations for its purchase were begun immediately. Frank A. Howard, a Chicago patent lawyer and engineer who had previously worked with Burton and Clark on the cracking process, came East to direct the necessary legal steps. When the transaction was completed in 1919, Mr. Howard stayed on in New York to organize a research and development department for Standard Oil Company (N. J.).

The plans for the new organization were, perhaps, the most comprehensive that had ever been drawn up for an industrial technical department. At the time, it had become the fashion for industrial companies to erect research laboratories. Jersey had done so some years before. But there existed a wide gap between the research lab, with its technically trained staff, and the actual business operations of the company. There was a real need for an intermediate organization, qualified to evaluate laboratory findings in terms of engineering and economics, to do the necessary development work and to put the new design, process or product in the proper form for consideration by the operating managers of the company.

This work had in the past been divided among three groups:

a) the research laboratory, which was supposed to be independent of all fetters and therefore of all coordination;

b) an experimental department which, if it existed at all, tended to become merely an adjunct of the manufacturing organizations;

c) a patent department, or outside patent law firm maintaining contact with the company through the office of the general counsel.

So far as is known, the Jersey company was the first industrial unit to group these three functions under a single management for the complete coordination of the major elements in the technical development program.

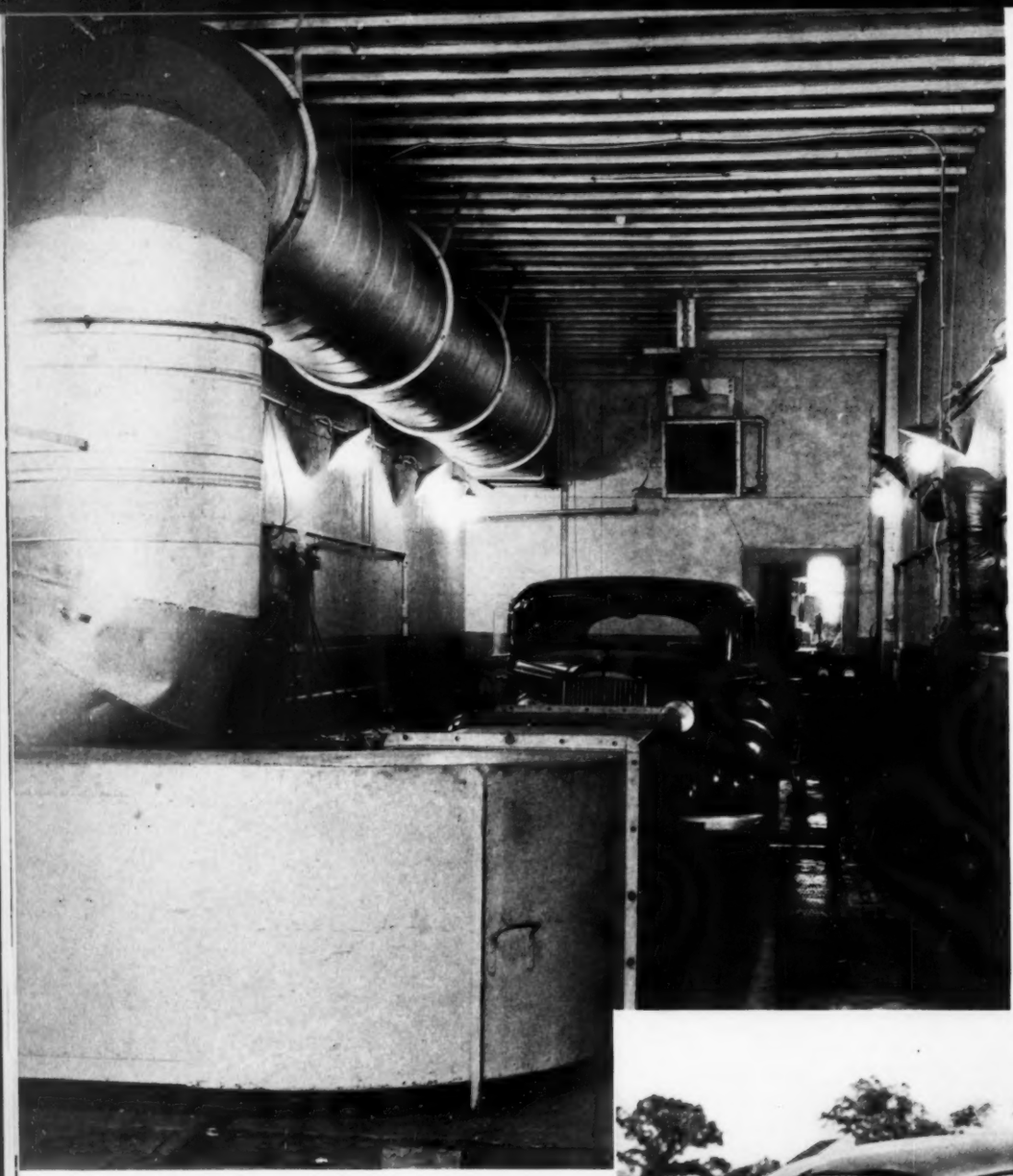
Shortly after the organization of the new Development Department, Melco Chemical Company's alcohol plant was loaded onto flat cars and sent off to Bayway. Thus, a puffing locomotive brought the chemical industry into the oil refining business. The prosaic arrival of what proved to be the second foundation stone in the Standard Oil Development Company was witnessed by the supervisor of railroads for the refinery. He waited long enough to see the engine roll to a stop and then headed for the nearest telephone.

To the general superintendent he reported, "Two carloads of the darndest looking junk I ever saw just arrived. What is it and where does it go?"

The report of the rail supervisor was typical of the alcohol plant's reception at the refinery. Most of the men felt that it wasn't needed. Bayway's job was to refine crude petroleum, not to worry about the gases that blew away every day into thin air or were burned under the stills when it was convenient to collect them. But there were others who saw a real tie-up between the cracking stills and the alcohol plant.

The organization of the Development Department, and the simultaneous establishment of the first petroleum by-product chemical industry at Bayway set the stage for the tremendous technical advances of the next twenty years.

It soon became apparent that the handling of patent rights in some 58 countries was a task ill-suited to the parent corporation, either from a legal or practical point of view. So in 1922 Standard Development Company was formed with Mr. Howard as president, for the purpose of acquiring, maintaining and licensing patent rights for the Jersey interests. Thereafter the new unit functioned with the Development Department, as the technical operating organization, under common management.



Above, dynamameter room at Bayway where fuels can be tested at 70 m.p.h. and temperatures ranging from −60 deg. F. to +120 deg. F. Right, adjusting thermocouple in field test. Sample fuels are carried on running board. Photos by John Hall for Esso Laboratories.

In the reorganization of 1927, the Standard Development Company became the corporate vehicle for all development activities; the General Engineering Department and the Standard Inspection Laboratories were merged into it; the name was changed to Standard Oil Development Company and Mr. Howard withdrew as president in favor of E. M. Clark, then a vice-president of the parent company. Mr. Clark retired in 1932 and Mr. Howard assumed the presidency of the Development company.

The present set-up includes R. P. Russell as executive vice-president, W. E. Currie, legal vice-president; E. V. Murphree, vice-president in charge of research and development; Dr. N. E. Loomis, vice-president directing technical services; and Dr. M. B. Hopkins as president of the Standard Alcohol Company and general executive in charge of chemical affiliations. Until January 1, 1941, H. W. Fisher and his commercial department were part of the S. O. D. but they have been transferred to the Standard Oil Company of New Jersey and given the name of Chemical Products Department.

The present Development company of more than 1,700 persons is a far cry from the little technical group of 1919. At that time chemical engineering scarcely was recognized by the petroleum industry. The two most pressing problems confronting those pioneers were more effective application of basic principles, already known for most refining processes, and adaptation of existing equipment to meet the steadily rising demand for gasoline.

The aid of Professor Warren K. Lewis of M. I. T., the late President Ira Remsen of Johns Hopkins and Dr. Robert A. Millikan, then professor of physics at the University of Chicago, was enlisted in recruiting a staff of the highest calibre to handle these problems.

The group plunged wholeheartedly into the work of redesigning existing refinery equipment. One of their first tasks was to find a way to treat heavy Panuco crude from Mexico, which Bayway was running but which seemed too much for the Burton-Clark stills to handle. Of high viscosity and low gravity, Panuco contained large quantities of sulphur.

An entirely new type of still was evolved to crack the Mexican oil and by the winter of 1920-21 the tube-and-tank process emerged from the experimental stage. Other problems

were solved in rapid order. Partial condensers gave way to highly efficient fractionating columns. Continuous tube distillation replaced the old batch stills. The use of flash vacuum stills was introduced into lubricating oil manufacture. New refining equipment employing the latest in alloys, high pressures and temperatures was developed and tested in service.

In the field of research, distillation of shale was studied in the early 20's. The ethyl chloride process (the only known commercial process) for making tetraethyl lead for Ethyl gasoline, was discovered. The application of hydrogenation to petroleum was developed and marked an important milestone in the history of Jersey's new technical subsidiary.

To undertake the study of high pressure catalytic processes such as oil hydrogenation a research center was founded at Baton Rouge. Professor R. T. Haslam of M. I. T.—now general sales manager for Esso Marketers, Jersey's domestic sales group—was given the task of organizing the new unit, and he recruited a large staff of able technicians, headed by R. P. Russell, to carry on the new line of catalytic research. The infusion of this new technology into the research program of the Development company has had a marked influence upon the company and the petroleum industry as a whole.

Within three years the group at Baton Rouge proved, first in a high pressure laboratory and then in a pilot plant, that by controlling conditions of hydrogenation in the presence of the proper catalyst, the process could be used to bring about almost any desired change in either the physical or chemical characteristics of practically all petroleum products.

It became possible to convert low grade refinery bottoms into saleable gasoline, obtain greater yields of exceptionally high anti-knock motor fuels without producing fuel oil at the same time, to improve the quality of burning oil and kerosene, to make lubricants equal to or better than the best obtainable from existing sources, to make petroleum solvents possessing far greater solvency.

As a result of these experimental results, large scale hydrogenation plants were built at Baton Rouge and at Bayway. The former today is the largest in the world engaged solely in making synthetic aviation gasoline. It produces more synthetic aviation fuels than all the rest of the world combined, with the exception of Germany.

During World War I, aviation fuels varied widely. Some were little better than the automobile fuels of that day, others were more volatile. It is doubtful whether by any modern standards the World War fuels would show as high as 65 octane and some would test as low as 50. Ordinary house brand motor fuel today is generally no lower than 72 octane.

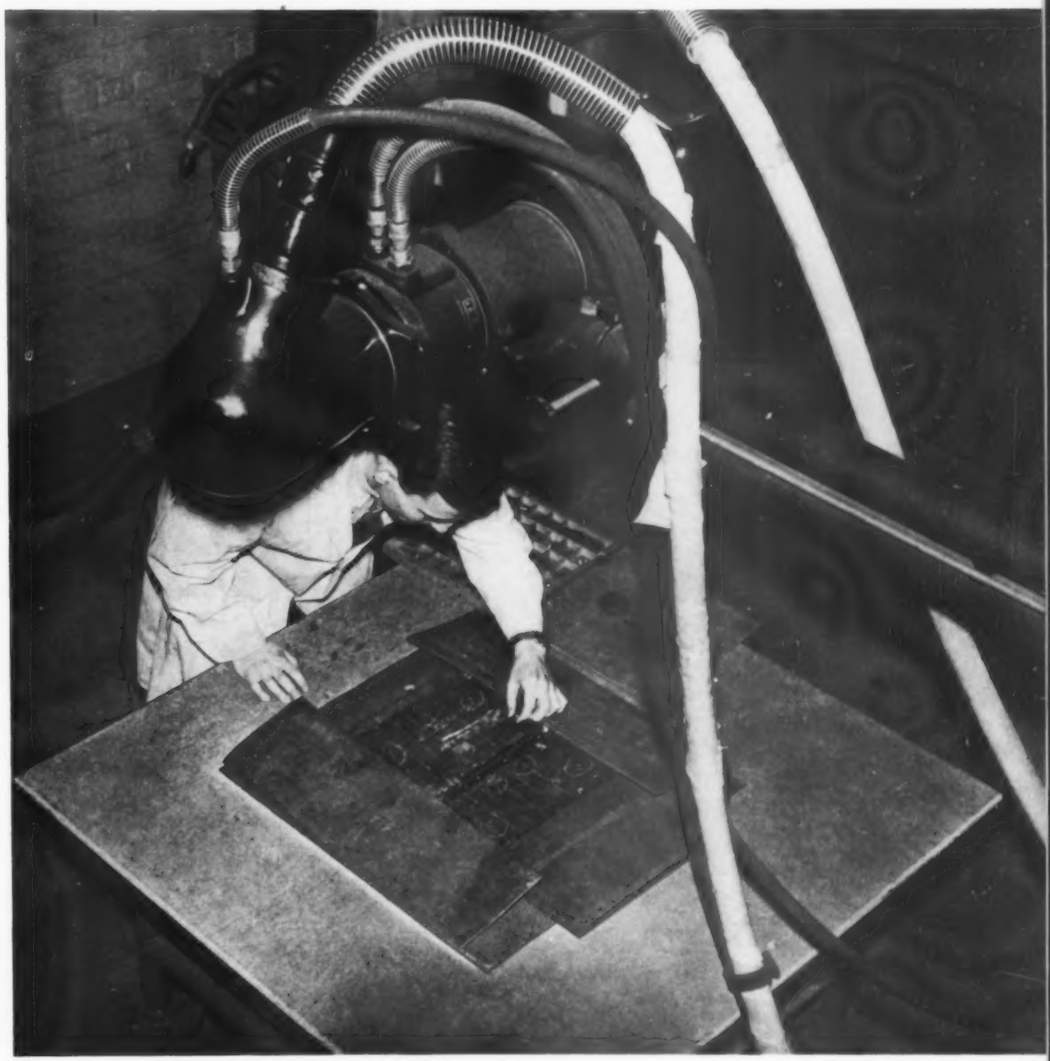
About 1930 the aviation world became knock conscious, and enlisted the aid of petroleum technologists and the engine builders. Aviation gasoline of 72 octane rating soon became the standard. Then, by adding Ethyl fluid, 80 and 87 octane gasolines were made available. However, the mere addition of lead to 73 grade fuel had a practical ceiling of about 90, so it was necessary to find another way to raise octane above that level.

Before long the S. O. D. pioneered in the commercial production of iso-octane, a blending fluid which, added to gasolines containing lead, raised octane numbers to 100 or better. The gold standard of motor fuels had been reached.

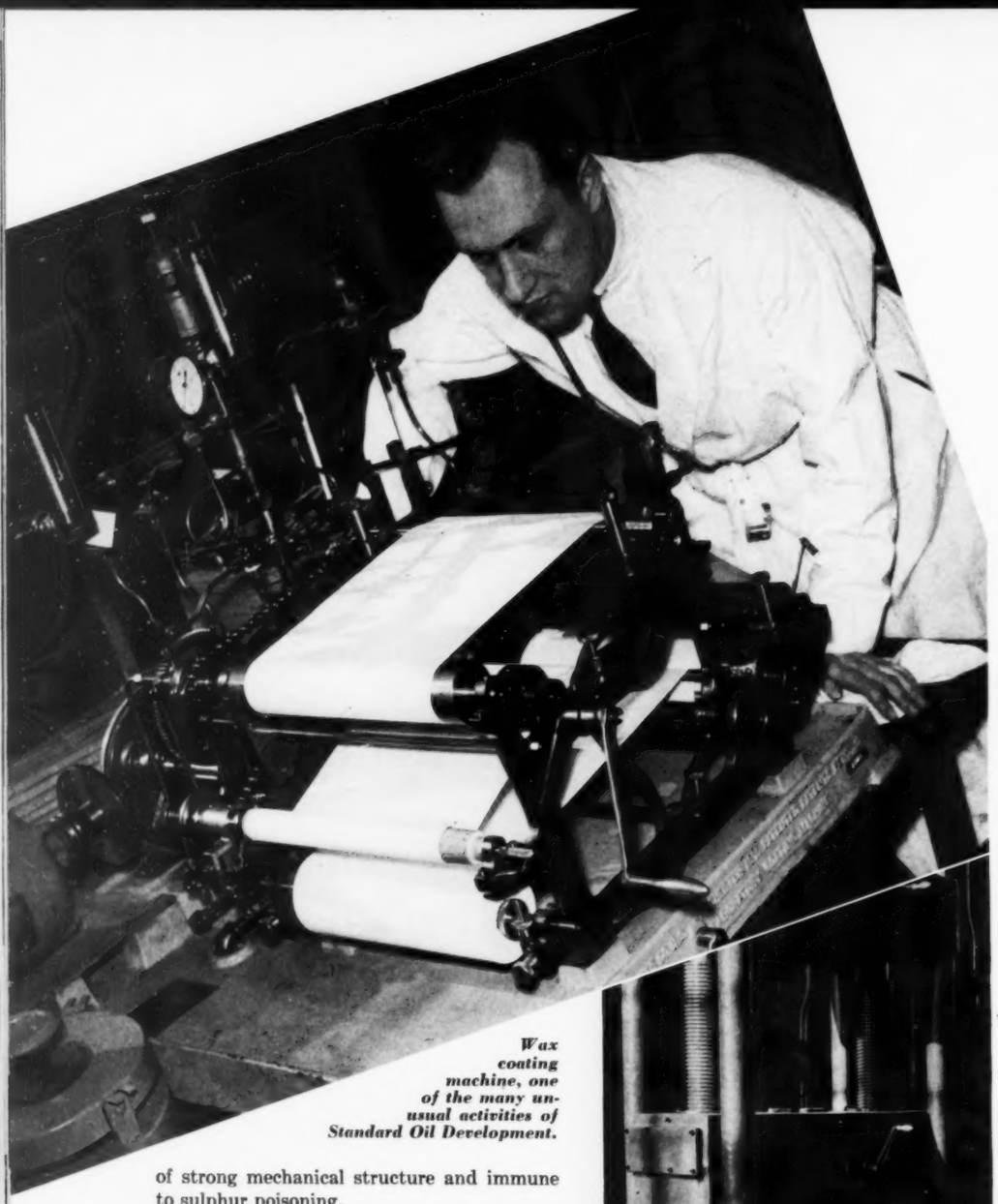
During the past few years S. O. D. has placed the greater emphasis on various catalytic refining methods in producing high octane aviation gasolines. These processes, of which hydrogenation is one of the most highly developed, are concerned with changing the structure of the petroleum hydrocarbon molecules with or without changing the size. Because it so closely approaches the processes of organic chemical synthesis, this modern trend is clearly toward chemical synthesis. The newest aviation fuels are outstanding examples of what can happen when chemists and chemical engineers start juggling molecules.

Most commercial super-fuels consist of a base stock (ordinary high quality aviation gasoline), plus a blending agent (iso-octane, isopropyl ether, etc.) plus tetraethyl lead. The base stocks usually came from the light, straight-run naphthas obtainable from a limited number of crudes. However, early work in hydrogenation by the S. O. D. demonstrated the possibility of producing synthetic naphthas which were essentially similar to those from selected crude oils and were superior in antiknock qualities.

As a result, a series of very active hydrogenation catalysts were developed and now are being used extensively for converting gas oil feed stock into the base stocks used in making premium grade aviation fuels of 100 octane or even higher. The new catalysts can be kept in continuous operation for more than a year on a commercial scale because they are



Portable 220,000 volt X-ray machine especially constructed by General Electric for testing materials as part of the work at Esso Laboratories.



Wax coating machine, one of the many unusual activities of Standard Oil Development.

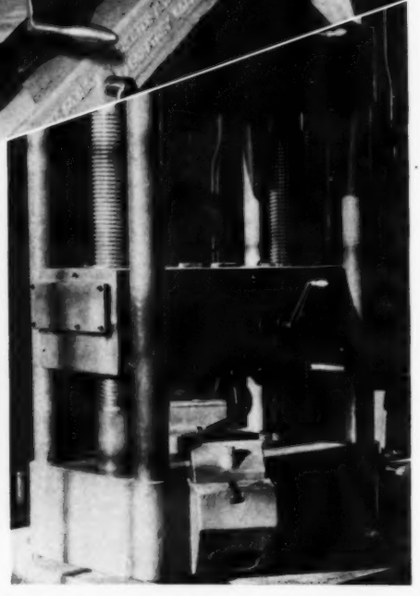
of strong mechanical structure and immune to sulphur poisoning.

The hydrogenation process also is being used to produce high octane number blending agents for use in 100 octane aviation fuels. In this work synthetic polymers, made by the co-polymerization of iso- and normal butylenes, are hydrogenated to yield branch-chain compounds of highly desirable qualities.

Prior to hydrogenation these polymers showed octane ratings of 82-84 and would not respond readily to the addition of tetraethyl lead. After hydrogenation, however, the octane numbers jump to 97-100 and they are more susceptible to lead treatment. These products are desirable as blending agents, although they are not serviceable as fuels in themselves because they do not have the proper boiling range. A different type of catalyst is used in this hydrogenation process which is carried on at somewhat lower pressures than in naphtha production.

The high pressure hydrogenation process, developed by Standard Oil Development Company for the manufacture of iso-octane by hydrogenating polymers has been generally adopted throughout the oil industry.

An interesting offshoot of the hydrogenation process is the so-called hydroforming method. For the first time, this makes possible the production of high grade aviation gasoline base stocks from low octane number naphthas. From the standpoint of national defense it is a major development. It can be used to supplant the usual thermal process of reforming for motor gasoline output, and any plants installed for that purpose in peacetime are potential producers of aviation fuels in case of national emergency.



Hydraulic tensile strength testing machine in action on steel bar. Strength of materials is another of Esso Laboratories and Standard Developments many activities at Bayway. Photos by John Hall for Esso Laboratories.

Because the branch-chain paraffin molecules in petroleum apparently are the most valuable in aviation gasolines, one new method in building up these recent synthetic fuels has been to take the lower olefin molecules—which normally are too volatile and gaseous for gasoline—and by polymerization, make them combine with themselves to form larger molecules which can be hydrogenated to produce a saturated fuel. Alkylation is a second method used to obtain the same saturated gasolines by a different route. The world's first commercial alkylation plant —1,200 bbl. capacity—has been in operation for some time at the Baytown refinery. It still is the largest commercial plant in operation, although others of important capacities also are in operation or are building.

The present commercial process of alkylation, in which sulphuric acid is the coupling agent, or catalyst, was developed through the combined efforts of the S. O. D., Angol-Iranian, Humble Oil, Shell Development, and The Texas Company research staffs. Working independently, these groups had each accomplished important technical advances contributing essentially to the same goal. In the best interests of the petroleum industry, and to speed development of a new major source for high-octane aviation fuels the groups combined their efforts.

One year before this cooperative arrangement was completed, the research and development organization of the Humble Oil and Refining Company, with the S. O. D., had put into operation the 1,200 bbl. a day plant at Baytown, Texas.

In one sense, this forward march of better and better fuels seems unending. No sooner was alkylation discovered and perfected that it became apparent the process required greater quantities of iso-butane than were available. So Standard Oil Development brought forth isomerization for converting normal butane into iso-butane. An interesting feature of this new process is that the same operation and equipment can be used to convert normal pentane into iso-pentane and the latter is another important ingredient in super fuels.

The S. O. D. has developed a new process for the production of ethyl chloride and has built a plant capable of turning out 20,000,000 lbs. a year at Baton Rouge for the Ethyl Gasoline Corporation. Particularly successful in developing addition agents for lubricating oils, the company has perfected a series of pour depressants, viscosity index improvers, oxidation inhibitors and oiliness agents. These reach the consumer under the names of PARAFLOW, PARATONE, PARANOX, etc.

Mentioned earlier in this story are the solvents which S. O. D. has perfected and which have played an important part in the amazing advancement of the synthetic resin and lacquer industries. Too, there are the various polymers of high, low, and medium molecular weight which are finding wide acceptance as plastics and rubber substitutes, such as VISTANEX and the Buna and Butyl synthetic rubbers.

JERSEY STANDARD Demonstrates Fluid Catalytic Cracking Process

NEW YORK, FEBRUARY 13:—Latest product of Esso Laboratories to reach the stage of commercial development was revealed to the public today when William S. Farish, president of Standard Oil Company (N. J.), and F. A. Howard, head of Standard Oil Development Company, staged a demonstration of the new fluid catalytic process of cracking in the Jersey Standard's board room in Radio City.

Existence of such a process of continuous catalytic cracking has been known and widely discussed in the trade but details have been closely guarded heretofore although three commercial plants are now under construction for the Jersey Standard group. One of these is located at the Bayway refinery of the Standard Oil Company of New Jersey, another at the Baton Rouge plant of Standard Oil Company of Louisiana and a third at Baytown, Texas, where Humble Oil and Refining Company is building a large unit. The Baton Rouge installation which the company describes as a medium size unit with an output of about 6,000 bbl. per day of finished gasoline is expected to be in operation before the end of the year while the others will go on stream early in 1942.

In commenting on the new process, Mr. Howard emphasized its importance as an advance in the technique of the cracking art. Its significance in this respect might be compared to that of the steam turbine as an improvement over earlier multi-cylinder engines in the field of power production.

"A chamber operating on the old principle of catalytic cracking," said Mr. Howard, "might be compared with a single cylinder engine. Oil vapor was passed through the chamber, which contained catalysts in the form of lumps or pellets, for perhaps twenty or thirty minutes. During this time carbon deposits accumulated on the catalyst, impairing its effectiveness.

"Consequently, it was necessary to stop operations, purge the unit to get rid of vapors and burn out the accumulated carbon with oxygen. All of this took more time than was consumed in actual cracking operations. Moreover the regeneration, or restoration of the catalyst in the chamber, required higher operating temperatures and much automatic apparatus which was quite expensive. In order to maintain continuous cracking operations in this type of catalytic process it was necessary to have several chambers, just as several cylinders are required to give an uninterrupted flow of power in an automobile engine.

"In the fluid catalyst process we maintain continuous cracking operations in one chamber, and regeneration, or cleaning of the catalyst, in a separate zone, through which the catalyst flows like a liquid. The only thing that moves is the catalyst itself and the operation is continuous, like that of a steam turbine."

Frank A. Howard (left) turns nitrogen into special apparatus to demonstrate flow of catalyst in new process while W. S. Farish explains one feature of the demonstration.

In answer to questions by interviewers, Mr. Howard said that the investment cost of a unit using the fluid catalytic process was less than that of one employing a fixed catalyst but about the same as a thermal cracking plant of like size. The advantage over the thermal system was in producing a higher test product. Using gas oil or a reduced crude as charging stock it was possible to produce about 50 percent per pass of gasoline ranging from 78 to 82 octane ASTM Standard. The catalyst can be derived from a number of products easily obtainable and suffers practically no loss from use.

In tracing the development of the fluid catalyst process, Mr. Farish revealed that a considerable amount of the intensive technical work carried on by the Standard Oil Development Company during the past few years had reached a successful conclusion during 1940.

"In hydrogenation, the most complex and highly developed of the catalytic oil processes, new catalysts were developed and successfully demonstrated in full commercial operations. The Baton Rouge hydrogenation plant is actually producing at the present time more than 100 percent by volume of gasoline from gas oil.

"In catalytic cracking, one of the most direct of the catalytic oil processes, the new, continuous fluid catalyst process proved to be so successful in a semi-commercial unit that it was decided to proceed immediately

(Continued on page 60)

WELDING TOOL JOINTS ON DRILL PIPE

By C. M. Taylor

The Lincoln Electric Co.

After drill pipe has been used for some time, the joints become loose and weakened due to the whipping action that takes place during drilling.

Especially in deep well operations, this condition of looseness at the joints is the concern of drillers because it results in leakage of mud pump pressure which should be maintained for most economical and speedy drilling. Moreover, it is sometimes dangerous, since failure of a joint (it usually twists off at last engaged thread) would result in the dropping of the string and the waste of considerable time and money for fishing out operations.

It is to overcome these conditions that many producers are welding the tool joints at both ends of every section of pipe. This makes possible a construction that is permanently strong and tight at the joint, making possible higher mud pump pressures at the bit, for faster drilling, and precluding twist offs at the last threads where they normally occur. Also, because the joints are permanently rigid, there is less whipping action, resulting in a straighter, more uniform hole which costs less to cement.

Standard A. P. I. joints:—Following is the procedure used by a tool company in the North Texas Field in the welding of drill pipe joints: Both the pin end (male joint) and box end (female joint) are tightened in a lathe under 15,000 foot pounds. This assures a tight seating of the threads so as to secure their maximum strength.

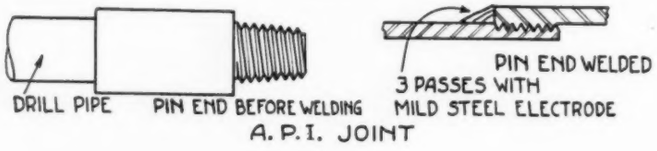


Figure 1.

Figure 1: pin end; The coupling is welded to the pipe with ¼-in. Type A shielded arc electrode. This is a roll welding operation with the welding operator doing the rolling with his left hand. Both ends of the pipe are mounted on rollers to facilitate turning and the pipe is turned by the welder with a standard pipe turner with a handle about two feet long. Three passes are made, producing a bead which slopes down from the top of the coupling shoulder to the pipe at an angle of about 30 deg.

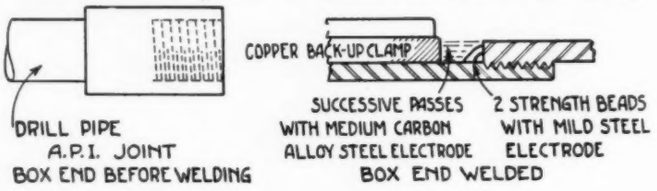


Figure 2.

Figure 2: box end; Two beads are first made with Type A shielded arc electrode for strength purposes. A copper back-up clamp is then used to apply a wear-resisting shoulder with a flat face up to the level of the joint. This weld, made with a medium carbon alloy steel electrode, provides a hard, flat surface which is desirable at this point because this is the point of contact with the elevator and is therefore the surface that must bear the entire load of the string below it, (when pulling out of hole). The back-up clamp is positioned between the clamp and the joint is filled up to the edge of the joint with medium carbon alloy steel electrode. This is a roll welding operation, the rolling performed by the welder.

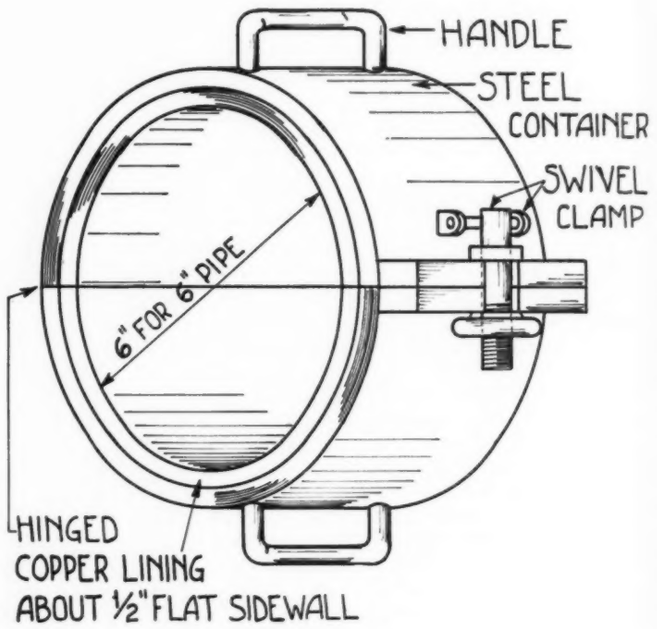


Figure 3.

Figure 3 shows the copper back-up clamp design used for this operation. Note: Instead of a medium carbon alloy steel electrode, some operators use a high carbon steel electrode for the final passes on the box end.

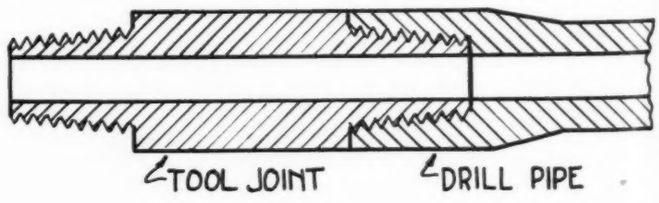


Figure 4.

Hydril Externally Upset Drill Pipe Joint:—A cut-away view of this type of joint is shown in Figure 4. Due to the upset section, this pipe is said to be the strongest drill pipe available, providing extra thickness of metal at the threads.

Constant rotation in drilling naturally wears down the outside diameter of the tool joint as well as the outside diameter of the drill pipe along the up-set portion. Since it is desirable to maintain the full section at the joint for maximum strength, the worn joint is reclaimed by arc welding, using the following procedure.

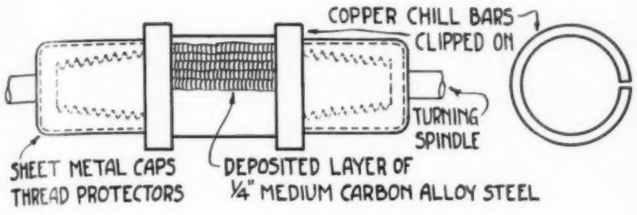

COPPER CHILL BARS CLIPPED ON
TURNING SPINDLE
SHEET METAL CAPS THREAD PROTECTORS
DEPOSITED LAYER OF ¼" MEDIUM CARBON ALLOY STEEL

Figure 5.

The joint itself is mounted on turning spindles as shown in Figure 5. The threads should be protected from spatter by a sheet metal cap designed to fit over them as shown. Copper chill bars should be used, positioned as shown at the ends of the joint. These chill bars help to absorb the welding heat from the tool joint and maintain original machined dimensions.

The most effective electrode has been found to be ¼-in. medium carbon alloy steel applied in longitudinal beads with 250 amperes. A single layer of the beads is applied all around the joint.

To build up the externally up-set section of the pipe it is important that the tool joint be inserted before welding in order to prevent undue contraction of the threads and to preclude remachining.

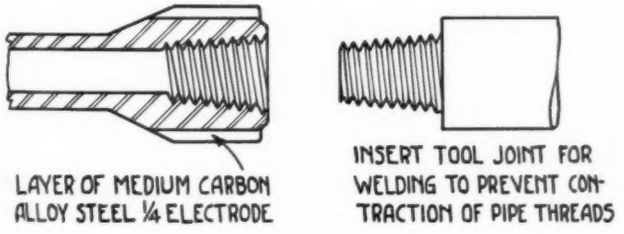


Figure 6.

The pipe can be mounted on rollers to facilitate turning. A single layer of beads run longitudinally with ¼-in. medium carbon alloy steel electrode is recommended as shown in Figure 6.

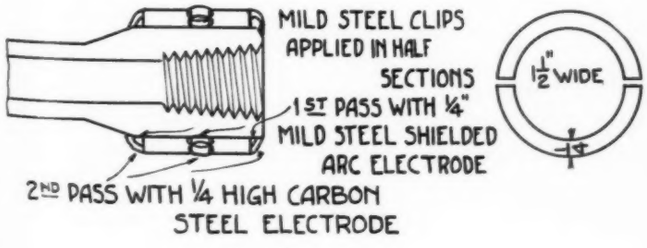

MILD STEEL CLIPS APPLIED IN HALF SECTIONS
1½" WIDE
1ST PASS WITH ¼" MILD STEEL SHIELDED ARC ELECTRODE
2ND PASS WITH ¼ HIGH CARBON STEEL ELECTRODE

Figure 7.

Figure 8.

Another method that has been found successful in building up the drill pipe is illustrated in Figure 7. By this method, mild steel clips approximately ¼-in. by 1½-in. are welded to the pipe in order to build up the surface. The first pass, joining the clips to the pipe, is made with ¼-in. shielded arc mild steel electrode. A second pass of ¼-in. high carbon steel electrode is then applied, making a flush joint but not overflush. In cases where the diameter of the pipe after completion must be exact, the drill pipe is machined to the proper size before welding.

Welding pin end of Standard A.P.I. Joint is shown in Figure 8.

Figure 9.

Completed pin end and box end joints are illustrated in Figures 9 and 10.

Figure 10.

Figure 11

Figure 11 shows another method of building up box ends of A.P.I. joints. Joints are machined about ⅛-in. to receive semi-circular medium carbon steel clips, (see Figure 12). Edges of clips are scarfed for maximum weld penetration. Initial passes are made with 5/16-in. mild steel coated electrode and finish passes with medium carbon alloy rod to resist impact and abrasion.

Figure 12

No Gasoline Rationing Expected in Canada

CANADIANS may be urged to conserve gasoline voluntarily; otherwise there is little likelihood of any government action toward rationing gasoline supplies, according to a recent article in CANADIAN OIL AND GAS.

The sudden flurry of excitement following Finance Minister J. L. Ilsley's references to gasoline rationing at the Sirois conference has died down. Mr. Ilsley was speaking of something that might happen; not announcing a definite government policy.

Government officials have been looking into gasoline rationing as a means of cutting down expenditure of foreign exchange but the last prepared figures on the subject showed a maximum saving of $10,000,000, or just under a fifth of Canada's foreign petroleum products expenditure. Studies have shown that there isn't nearly as much purely pleasure motoring as is believed and there never has been any thought of curbing gasoline for tourists—the biggest single source of pleasure consumption.

In Canada, unlike England, there is no problem of gasoline production or transport: rationing would be purely a matter of conserving foreign exchange.

Foreign exchange control officials—the tightest-fisted group in Ottawa—are not sure that they want gasoline rationing as a gift in their programme of saving U.S. dollars. Granted that U. S. tourists would be free to burn up all the gas they wanted, there is fear that the very fact that rationing was in force in Canada would keep tourists away.

There has been no indication officially of government policy, but it is believed that a gasoline-less Sunday a month, or oftener, will be tried. This, it is believed, will be fairly simple to enforce as the only pressure needed would be the pressure of public opinion. Doctors' license plates would solve their problem. The gas holidays may be tried on a purely voluntary basis.

So far war demand has made little difference to the Canadian gasoline business. The oil companies cooperated with the department of munitions in establishing a reserve supply of aviation gasoline which now amounts to a full year's needs for the Royal Canadian Air Force. The companies are storing this aviation fuel at their own expense, supplying it, as wanted, to the air force.

Oil at Quator

FOR some time past exploratory drilling has been carried on at Howar in the Quator peninsular, not far from Bahrein, by the Petroleum Development (Quator) Ltd., a subsidiary of Petroleum Concessions Ltd., which is composed of the same international group as the Iraq Petroleum Company Ltd. Oil has been discovered in commercial quantities, but development of the field is delayed by war conditions.

Foreign Oil Legion

GUY WELLMAN, general counsel, Standard Oil Company, N. J., has retired under the company's annuity plan. For many years one of Mr. Wellman's duties has been the direction of the Near East Development Company, which is the American group participating in the Iraq Petroleum Company, Ltd., and Petroleum Concessions, Ltd. After the World War he conducted important legal matters in connection with Standard Oil reparations claims and negotiations leading to the formation of the Iraq Petroleum Company.

Guy Wellman

G. R. HEYL, who has been doing oil geology work in Colombia has returned and now is assistant state geologist for the Arkansas Geological Survey.

WILLIAM T. WALLACE, vice-president of the Gulf Oil Corporation, died January 20 at his home on Long Island at the age of 68. Mr. Wallace had been sick for some time prior to his death. Born in Canada, Mr. Wallace grew up in Rochester, N. Y. and became general agent for Mexican Gulf Oil Company in 1912. Following the World War he transferred to New York and had charge of Gulf's overseas exploration and production activities. His work took him to many remote parts of the world and he was thoroughly familiar with petroleum developments in Colombia, Venezuela, Ecuador, England and Denmark.

Viscount Charles Wakefield

VISCOUNT CHARLES CHEERS WAKEFIELD, one of England's well known oil men died on January 15 at the age of 81 in London. Despite his advanced age Lord Wakefield was active in the affairs of his company, W. A. Wakefield & Co., Ltd., until his death. The company had built up a substantial business in blending and marketing lubricating oils and greases.

Cosmo-Sileo

E. S. Crosby, president of the Johns Manville International Corporation leaving New York on the Grace Liner, Santa Elena for a thirty day business trip to South America, on January 31.

HARRY G. SEIDEL president of the Council of Management, International Association (Petroleum Industry) Ltd., and director of the Iraq Petroleum Co. Ltd., London, England, will shortly return to the United States. Two other American officials are remaining in London, namely, P. T. Lamont and W. R. Carlisle.

Cosmo-Sileo

B. A. Myers and F. B. Bimel, directors of International Petroleum Company leaving New York on January 31 aboard the ss. Santa Elena for a six weeks tour of the company's properties in Colombia, Ecuador and Peru.

FRANK L. HERLE and Joel H. Hirsch, formerly with the DeFlorez Engineering Company, New York City, announce the opening of a consulting engineering partnership under the name of Herle and Hirsch, with offices in the Wheeler Kelly Hagny Building, Wichita, Kansas.

A. C. STEWART, grandson of the founder of Union Oil Company, was appointed director and vice president in charge of sales on January 1. Mr. Stewart started work for Union in 1928 as a service station employee following his graduation from Stanford and completion of a course at the Harvard School of Business. Mr. Stewart is well known in offshore racing circles having participated in the Honolulu and Bermuda races.

A. C. Stewart

Curtis Wilshire

W. F. Knode

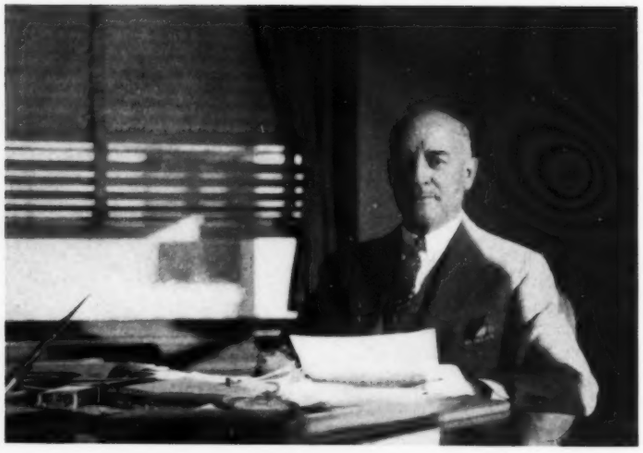
W. F. BILL KNODE, a senior member of the firm of Foran, Knode, Boatright & Dixon, consulting petroleum engineers of Houston, Texas, and Calgary, Alberta, Canada, has recently resigned to enter private consulting work, and has established headquarters in Corpus Christi, Texas.

M. E. Montrose

M. E. MONTROSE, general sales manager of Lane-Wells Company for the past eighteen months, has been elected vice-president of the company, according to an announcement made by Walter T. Wells, chairman of the board. As vice-president, Mr. Montrose will continue to direct the company's commercial sales activity.

A. E. FATH, Socony-Vacuum geologist at Madrid, Spain, is now located at the company's headquarters in New York.

T. E. J. UMBEC, who until this summer was treasurer of the International Association (Petroleum Industries) Ltd., London, is now with the tax department of the Standard Oil Co. N. J. in New York.



Above, Fred Kay.

G. W. Gordon with seven foot sail fish captured off Aruba.

G. W. GORDON, director of overseas refinery construction and operation for the Standard Oil Company, New Jersey, is leaving on one of his regular inspection trips to the company's refining plants in the Carribean. On the occasion of his most recent visit he found an opportunity to do a little big-game fishing a mile or so off the coast of Aruba, and after an hour's tough fight landed with rod and line a fine specimen of sailfish weighing 51 lbs. The fish was 7 ft. long by 32 in. across the tail and had a magnificent sail 26 in. deep.

ING. C. R. VEGH GARZON, manager of ANCAP, Uruguay's petroleum monopoly, has changed his headquarters to San Salvador 2040, Montevideo, Uruguay.

FRED KAY, director, and manager of exploration, Standard-Vacuum Oil Company, recently returned from a trip to Netherlands India. Previously Mr. Kay visited Papua in connection with exploration work now being carried on, and went to Australia where the company is engaged in marketing.

ROSS PRESTON, an American member of the crew of the British tanker, San Demetrio, has been awarded £1,000 by the Admiralty Court, London, as his share of the salvage by 16 men of this gasoline-loaded ship after she was torpedoed and abandoned on November 5 last. Justice Langton, presiding at the proceedings, stated that no finer tribute could be paid to Preston than the unanimous request of all on board that the Red Ensign of the British merchant marine flown by the San Demetrio be presented to their American shipmate. The heroic salving of the blazing San Demetrio, with her bridge and steering gear blown away, and with but four bare spokes left on the after steering wheel will make one of the historic stories of the high seas. The salvage crew steered the vessel by the stars and position of the sun for six days and docked safely with 10,000 tons of gasoline.

H. E. BEDFORD, member of the management council of the International Association, (Petroleum Industries) Ltd. has returned to London by plane, having left on February 1st.

THOMAS W. PALMER, counsel heading the Latin-American law department of the Standard Oil Company, N. J., has been honored by the Instituto Ordem dos Avogados Brasileros, Rio de Janeiro, with a membership. Only one other North American has been admitted to this South American bar association. After nomination by five Brazilian lawyers a unanimous vote was necessary.

PITHECANTHROPUS ERECTUS . . .
Could Not Understand

Primitive man displayed his reverential awe of Nature's Forces by fearful apprehension.

As intelligent familiarity developed, man learned that these phenomena were not capricious . . . but obeyed rigid laws that could be recognized and cataloged . . . he learned that some of these forces could be harnessed and put to work.

The present day application of Centrifugal Force is indeed awe-inspiring . . . it is able in a fraction of a minute to locate, seize, and to remove droplets of water distributed thruout an oil . . . and the power of Centrifugal Force may be directed to separate any two immiscible liquids having different specific gravities . . . and coincidentally remove solids from both liquids . . . a simultaneous triple separation.

Such miracles are complacently accepted . . . we understand why they happen . . . we have learned how to put Nature's Forces to work for us.

THE SHARPLES CORPORATION

SHARPLES

Representatives throughout the world

★ *CENTRIFUGAL AND PROCESS ENGINEERS* ★

2323 WESTMORELAND STREET · PHILADELPHIA · PA.

LONDON PARIS TOKIO

NEW YORK BOSTON PITTSBURGH CLEVELAND DETROIT

CHICAGO DALLAS SEATTLE SAN FRANCISCO LOS ANGELES

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry, Edited by Dr. O. W. Willcox

GEOLOGY

Role of Carbohydrates in Formation of Oil and Bituminous Coals—E. Berl, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, vol. 24 (1940), No. 11, pp. 1865-1890.

The writer, with the help of collaborators, has studied the conversion of carbohydrates and lignin derivatives. It has been found that lignin and its derivatives play a rôle only in the formation of lignites. Oil and bituminous coals are formed mostly from the carbohydrate content of plant materials. It has been found that the conversion of algae into the so-called "protoproduct" can be carried out very easily in the presence of alkaline-reacting material like limestone. Ammonia formed during the decomposition from albumen acts like limestone. By further removal of oxygen by the process of intramolecular combustion or by hydrogenation, for instance in presence of bi-valent iron, materials containing less oxygen with asphalt-like properties are obtained. Further removal of oxygen by cracking or hydrogenation leads to oxygen-free hydrocarbons in which aliphatic, hydroaromatic and aromatic hydrocarbons can be found. During this conversion methane and its homologues are formed.

Experiments have shown that algae and other carbohydrate-containing materials and the so-called protoproduct react with gypsum under formation of calcium sulphide which upon hydrolysis forms lime and hydrogen sulphide. Lime furnishes the necessary alkaline reaction for the conversion of carbohydrate material into its conversion products. Hydrogen sulphide acts as a hydrogenating agent with formation of sulphur.

It seems that for the first time the formation of oil-like and bituminous coal-like material could be carried out in the laboratory in just the same way as nature produced from the same raw material those most valuable end products—crude oil and bituminous coals.

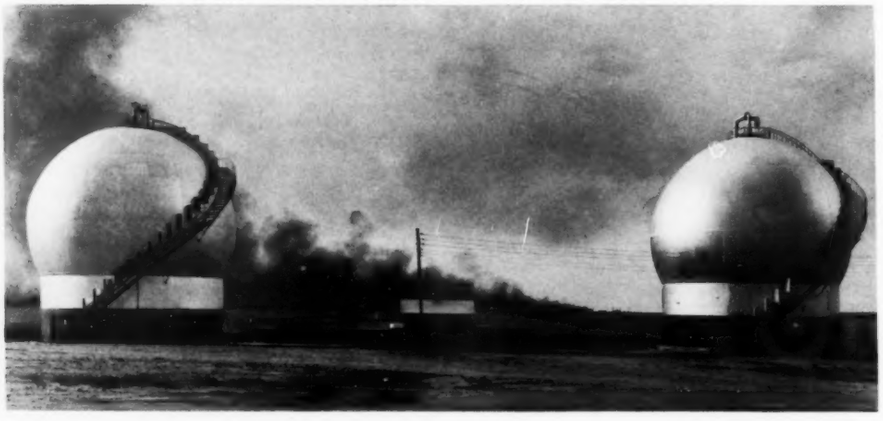
Foraminiferal Correlations in Eocene of San Joaquin Valley, California—Boris Laiming, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, vol. 24 (1940), No. 11, pp. 1923-1939.

The writer presents evidence to prove the value of the smaller Foraminifera as a basis for correlating Eocene strata in California. A study of foraminiferal sequences in a number of sections taken from widely separated areas shows that the general order of superposition of microfaunal assemblages remains constant, even in the presence of variable lithologic conditions. Charts are presented, indicating the position and correlation of foraminiferal zones and formations in various surface and subsurface sections of the Eocene in San Joaquin Valley. Comparison is also made with Eocene formations in other localities. The vertical ranges of the faunal assemblages and of some characteristic species are shown in a graphic chart.

Eocene Exploration in California—F. A. Menken, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, vol. 24 (1940), No. 11, pp. 1940-1949.

Although Eocene production has been known in California for 40 years, it was not recognized as an important producing zone until the recent discovery of Eocene production at Kettleman Hills and Coalinga. The stratigraphic types of accumulations as at Coalinga have been the impetus for detailed study of Eocene deposition and distribution. The Eocene of California is characterized by unconformities, lenticularity, facies changes, and extreme variations in thicknesses. The present trend is toward remapping of the outcrop section, correlating and rezoning of the formations and delineation of possible stratigraphic and structural prospects. From present data it appears that the most likely area for future Eocene discoveries is the west-central and southern San Joaquin Valley. The Santa Maria Basin and western Los Angeles Basin are void of Eocene. The prospects in the Santa Barbara, Coastal, and Santa Clara Valley provinces are limited by reason of apparent lack of porosity.

Two 10,000 bbl. Wyatt pressure spheres in the Texas Panhandle used to store charging stock for a poly plant. Working pressures are 95 lbs.



DRILLING

Drill Pipe Corrosion—V. V. Mason, before AMERICAN INSTITUTE MINING & METALLURGICAL ENGINEERS, Petroleum Division, Los Angeles, October, 1940.

Drill pipe corrosion and corrosion fatigue have been made prominently evident by present day deep drilling. Little in the way of specific remedies are found in the literature and very little has been done in research by field trial of the theories that have been advanced.

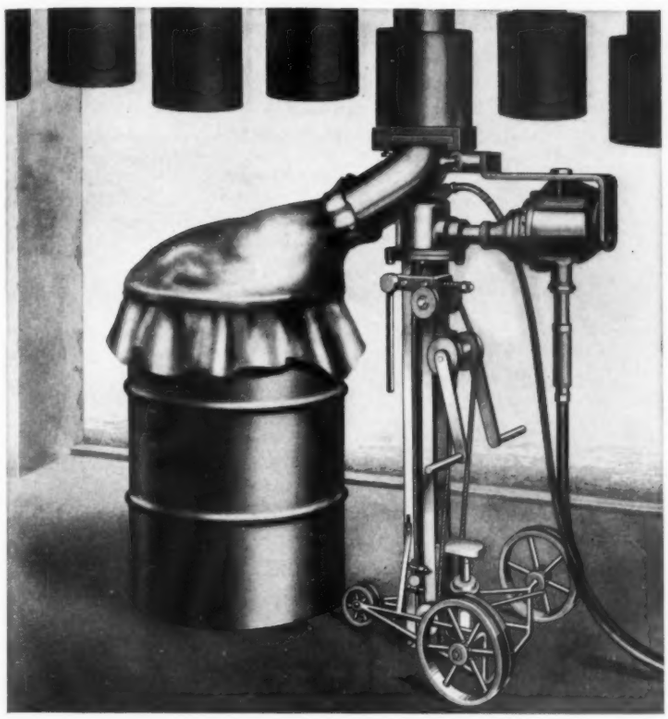
After a study of the literature, field trial of the two theories appearing to have the best possibilities are being made. At present the results indicate that the reduction of stress and the removal of mill scale from the interior of the pipe by grit blasting are possible methods of limiting the condition.

Hydraulics of Mud-Circulating Systems—Wesley W. Moore, before AMERICAN PETROLEUM INSTITUTE, Chicago, November, 1940.

This discussion deals with a preliminary analysis of the problem of circulating an average rotary-drilling mud down to and back up from the bottom of the well bore in such volume and at such velocity as effectively to remove drill cuttings from the face of the formation being contacted by the drill bit and to transport such cuttings up to the surface, where they can be deposited.

The useful work accomplished by the circulating mud stream is normally very small in relation to the energy expended. Much of the hydraulic energy, furnished by the slush pump, is consumed by friction head within the drill pipe; whereas no useful work is accomplished by the mud stream until after it has left the drill bit.

Experience has taught that certain combinations of drill-pipe size, hole diameter, and rate of circulation are conducive to successful and economical drilling operations. Relatively high mean velocities in the returning mud stream appear to be an important factor in this connection and, although desirable, often are limited in application by friction head developed within the mud-circulating system—particularly within the drill pipe itself. Within practical limits the friction head (or pressure drop) developed in any given mud-circulating system varies as the 1.85 power of the mean velocity of flow within the system, whereas the hydraulic-horsepower output



New

AIRETOOL CATALYST TUBE CLEANERS

CLEAN CATALYST TUBES SAFELY WITHOUT USE OF PROTECTIVE CLOTHING

Gone is the danger of severe burns from cleaning catalyst tubes! Gone is the danger of tube corrosion! Gone is the necessity of slowing down operators with heavy rubber clothing and respirators! Airetool's new Catalyst Tube Cleaners eliminate these dangers and inconveniences. The spent catalyst is cleaned out and deposited in receptacles connected with the cleaner's discharge opening or removed by an exhaust fan or conveyor system.

CLEANING TIME AND LABOR COST REDUCED

In a recent demonstration of the Airetool Catalyst Tube Cleaner, the cleaning time was actually reduced 75%. The labor cost was cut 50% and dust was eliminated from the surrounding atmosphere.

VARIOUS TYPES AVAILABLE

Airetool Catalyst Tube Cleaners are being made for vertical reactor tubes, catalyst converter and tower type units. Each is guaranteed to perform properly and eliminate the present operating hazards.

SEND FOR COMPLETE DESCRIPTION

Our new Bulletin WP-59 tells the complete story. Send for it at once.

OTHER AIRETOOL REFINERY SPECIALTIES

TUBE CLEANERS

Airetool also manufactures a complete line of tube cleaners ranging in size from ½" to 20" I.D.

FLY CUTTERS
TUBE JIGS
PLUG SEAT PROTECTORS
TUBE GAUGES
CALIPERS
POLISHING AND BUFFING MOTORS
TOOL TRUCKS
PLUG RACKS

AIRETOOL MFG. CO.

SPRINGFIELD, OHIO

Representatives in Principal Cities — New York Office — 50 Church St.

When loosely consolidated sands are encountered, AQUAGEL consolidates the formation, preventing caving, and speeds up drilling. • Low water loss AQUAGEL-water muds, either straight or in combination with BAROCO where salt water is encountered, tend to promote faster, safer, more economical drilling.

PATENT LICENSES, unrestricted as to sources of supply of materials but on royalty bases, will be granted to responsible oil companies and operators to practice the inventions of any and/or all of United States Patents Nos. 1,575,944; 1,575,945; 1,807,082 and 1,991,637 and further improvements thereof. Applications for such licenses should be made to the Los Angeles office.

B A R O I D P R O D U C T S

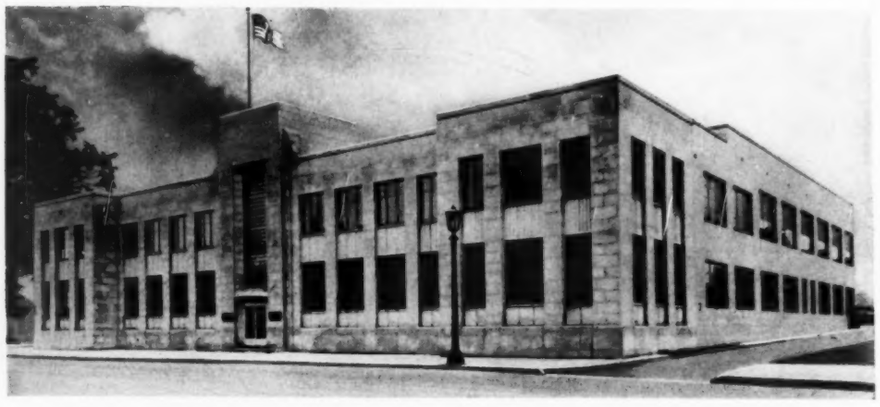
BAROID and COLOX • AQUAGEL • STABILITE • BAROCO • FIBROTEX • AQUAGEL for CEMENT • SMENTOX • ZEOGEL • IMPERMEX • MICATEX • TESTING EQUIPMENT • BAROID WELL-LOGGING SERVICE

BAROID SALES DIVISION
National Lead Company

Baroid Products and Service Engineers are available in all active oil fields in the U.S.A.

BAROID SALES OFFICES: LOS ANGELES • TULSA • HOUSTON

New offices of Arthur G. McKee and Company in Cleveland, Ohio.



of the slush pump, which maintains this circulation, varies as the 2.85 power of such velocity. In view of these relationships it is apparent that if the power requirements of the slush pump are to be kept within reason, and if the mean velocity of the returning mud stream also is to be kept at the desired higher rate, careful attention must be given to one important factor in the mud-circulating system, viz., the relation of the hole diameter to drill-pipe size.

Results in practice, so far as they have been observed, seem to confirm the theoretical advantage of keeping the ratio of drill-pipe size to hole diameter as high as possible, and yet retain adequate clearance for fishing operations.

REFINING

Refining Pennsylvanian Oils with Furfural—F. T. Mertens, in OIL & GAS JOURNAL, Vol. 39 (1940), No. 26, pp. 47-48.

The author takes the stand that, from the point of view of the lubricant market, oils from crude sources other than Pennsylvania have been so improved by solvent treatment as to materially reduce the natural advantage enjoyed by Pennsylvania oils in the past. Continued leadership of the modern market by Pennsylvania oils can be assured in the future only by the use of effective solvent refining.

As applied in two Pennsylvania installations the crude charge is distilled into wax distillate and cylinder-stock bottoms. If no solvent dewaxing is employed, the wax distillate is processed with the furfural process following the rerun operation (viscosity reduction) and preceding the clay finishing. Cylinder-stock bottoms are first furfural-refined, then clay-treated, centrifuge-dewaxed and reduced as before. If a solvent dewaxing process is included, a viscous wax distillate is produced at the still and finished to neutral-oil specifications without further reduction. This distillate is furfural-refined, solvent-dewaxed and clay-finished; the corresponding cylinder stock being treated likewise.

An argument in favor of the process is found in the fact that neutral oils obtained from Pennsylvania distillates are known to be relatively unstable, when produced by conventional refining methods. The degree of stability is not reflected in the above test results either on the charge or raffinate. Such characteristics can be determined only by engine-block tests or road tests. However, the effectiveness of the furfural refining process has been amply demonstrated by numerous tests of both types, which indicate materially increased stability and decreased sludging tendency in furfural refined oils. Hence, these oils make it possible to keep an engine free from lacquer and sludge formation over long periods of time.

From the point of view of refinery operation, the use of furfural has reduced the percolation filter costs by increasing the filter yields from 50 to over 300 percent.

New Refining Process (Gulf Polyform Process)—Paul Ostergaard and Eugene R. Smoley, in WORLD PETROLEUM, Vol. 11 (1940), No. 9, pp. 68-79.

In this paper is described a process which consists essentially in mixing the oil stock with various amounts of normally gaseous hydrocarbons, particularly propane and butanes, and subjecting the mixture to thermal cracking at temperatures and pressures appropriate to each

For the production of Aviation Gasoline

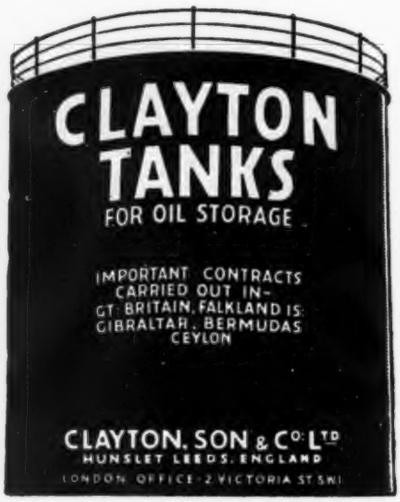
ALKYLATION

Acid Catalytic Alkylation Plants for operation on three entirely different types of feed stock have been engineered by Foster Wheeler. Each plant is developed to best meet the particular requirements of the individual refiner.

Isomerization, polymerization and close fractionation units designed and constructed complete for alkylation feed stock preparation. Highest practical octane alkylate — essential for most economical production of quality aviation gasolines — is obtainable only by specialist engineering.

FOSTER WHEELER
CORPORATION
165 Broadway
New York, N. Y.

FOSTER FW WHEELER



case. The technological advantage of this process is that when thus mixed, the oil can be subjected to higher temperatures than would be possible without excessive coke formation in the cracking tubes; as a result of the higher temperature there is a higher degree of conversion per pass. In addition, the yield of gasoline is greater and the gasoline has a higher octane value than can be obtained by subjecting the same oil to a conventional cracking operation.

The process has great flexibility and adaptability to various stocks. In one modification naphtha can be processed to yield 80-84 octane number gasoline which contains 20 to 35 percent of aromatics, mostly toluenes and xylenes. The process has already had four years of satisfactory operation with five units and two new ones are in process of erection.

ECONOMICS

The Effect of Curtailment on Local Taxes—Walker S. Clute and Milton W. Lewis, before AMERICAN INSTITUTE MINING AND METALLURGICAL ENGINEERS, Petroleum Division, Los Angeles, October, 1941.

Drastic curtailment of oil and gas wells has brought with it a new relationship of local taxes whereby the tax levies are materially increased with respect to the lowered production and earnings of the properties. The reasons for this are twofold: (1) the remaining high capacity to produce after each year's curtailed production, leaves a great amount of oil reserves to be assessed over and over again, and (2) the normal producing period is extended from 15 to more nearly 25 years, adding additional period for assessments; and at the same time costs of producing as well as taxes are increased.

Computations have been made covering the probable assessments upon sizable wells through their future lives, as compared with openflow wells of the same initial capacities. It is found that representative wells may pay in total more than twice the taxes that would have been levied had the wells been produced at open-flow rates. The factors used to provide for curtailment in various assessing methods have been analyzed and are here demonstrated by a new presentation of a series of present worth decline curves, with a view to ascertaining whether present methods give full recognition to curtailed values. Direct engineering appraisals were prepared for future years, and comparison shows that present assessment methods usually result in reasonable annual values under curtailed conditions.

However, neither of the latter methods approach the total lower assessments of wells formerly producing at open-flow rates when valued on that basis. Hence it is found that the total valuations on sizable curtailed wells increases the assessments in a manner which appears not only to place a penalty on curtailment, but also to impose an extra tax burden on the oil industry.

Any relief from this lies in the best recognition of these circumstances that can be granted by the taxing authorities so that no error be made toward the higher side of the valuations found for tax purposes.

BOOKS

Annual Reviews of Petroleum Technology, Vol. 5 (covering 1939)—F. H. Garner, general editor; published 1940 By Institute of Petroleum, Birmingham, England; 457 pages; 11s.

Owing to the current European war the fifth volume of this valuable publication was published under numerous difficulties. On the one hand, restrictions have caused omission of many developments of 1939, and on the other hand the compilers of many of the chapters were handicapped by inability to obtain access to published information. Added to these is the voluntary censorship exercised by the Institute of Petroleum which required deletion of certain technical and statistical data.

Nevertheless, the book has not suffered any appreciable decrease in size, and its content shows striking evidence that progress is continually going on in all branches of the industry, especially in the many-sided refining art. A new feature is a chapter on "Addition Agents" by J. R. Sabina, which reflects the growing importance of these adjuncts in lubrication. All to-

LEACH EXCHANGERS
for
High Temperatures
High Pressures

Fracto Control

High Heat Transfer
Low Vapor Pressure Drop
Long Tube Life
Easy Cleanability

Leach Exchangers are fully protected by U. S. and foreign patents

C. H. LEACH CO.
117 Liberty St. New York

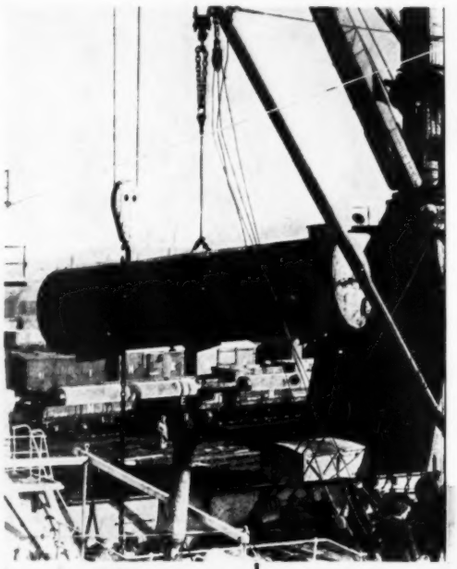
RENOLD

Designed and made to A. P. I. specification by the world's leading driving chain makers.
Send for leaflet No. 216/32
THE RENOLD & COVENTRY CHAIN CO. Ltd.
MANCHESTER, ENGLAND
Agents throughout the world

Marmon-Herrington all-wheel-drive truck is shown here hauling New Zealand field artillery to the siege of Bardia. Familiar to oil men in the United States and abroad, these trucks have been used further east in the construction of the Iraq pipeline.

Exporters of steel for over thirty-seven years, the UNITED STATES STEEL EXPORT COMPANY continues to serve the Oil Industry throughout the world with quality steel products. Seamless Steel Boiler and Cracking Still Tubes in regular Carbon, Alloy, Stainless and Heat Resisting Steels. Seamless Drill Pipe, Casings and Oil Well Tubing. Line Pipe. Wires, Wire Rope and Cables. "Unaflo" Oil Well Cement. Lumnite Cement. U·S·S High Tensile Steels. Galvanized Steel Sheets.

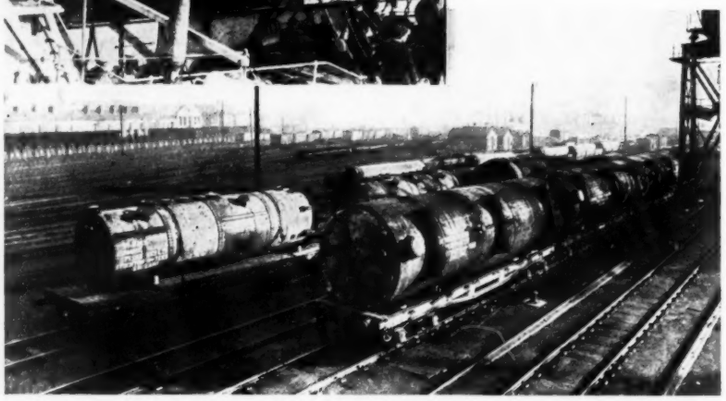
UNITED STATES STEEL EXPORT COMPANY
30 CHURCH STREET, NEW YORK, U. S. A.
Cable Address: "Steelmaker", New York



ASHMORE, BENSON, PEASE & CO., LTD.
STOCKTON-ON-TEES

For the

PETROLEUM INDUSTRY



Shipment of a consignment of over 600 tons of Oil Refinery Plant from our Works

WELDED PRESSURE EQUIPMENT

DISTILLATION PLANTS	:	STABILISERS, STRIPPERS
BAROMETRIC CONDENSERS	:	VACUUM TOWERS
EVAPORATORS	:	FRACTIONATING COLUMNS

OIL DISTRIBUTION

The Great Western Railway Company's South Wales Docks at CARDIFF, SWANSEA, NEWPORT, BARRY, PORT TALBOT and PENARTH (Harbour) are excellent terminals for oil distribution.

SWANSEA DOCKS is one of the greatest oil ports in Great Britain.
Important oil depots have also been established at CARDIFF and at PENARTH (Harbour).

SITES FOR NEW DEPOTS ARE AVAILABLE

For information apply to the respective Dock Managers or to :—

W. J. THOMAS,
Chief Docks Manager,
Great Western Railway,
CARDIFF

OIL TANKERS AT SWANSEA DOCKS

JAMES MILNE, *General Manager,*
Paddington Stn., London, W.2.

gether, these annual reviews continue to be indispensable to the petroleum technologists who want to keep up with the ceaseless stream of developments.

GENERAL

A Study in Well Spacing—M. G. Cheney, before AMERICAN INSTITUTE MINING AND METALLURGICAL ENGINEERS, Petroleum Division, Tulsa, October, 1940.

The history of the Sinclair-Moren pool in Young County, Texas, is reviewed. A test well was drilled near the center of a 372-acre lease on a plunging anticline. For 10½ years no competing well was drilled in the neighborhood and by that time the well had flowed 1,160,000 bbl. of oil and was still flowing 90 bbl. against 120 lbs. pressure. Aside from absence of competing wells, the long life of this well is ascribed to conservation of a large original supply of free and dissolved gas, and to a fairly thick oil-bearing sand.

Subsequent development work indicates that this well was efficiently draining an area of at least 100 acres, and as the situation is now reviewed the drilling of seven closely spaced holes around the original well was largely unnecessary. This case appears to demonstrate again that close spacing may easily be overdone, and that increasing the number of outlets from the reservoir may be at the expense of producing efficiency. It also indicates that recently enacted legislation prescribing 20 to 40 acre-spacing for oil wells has a reasonable basis of conservation.

Measurements of Consolidated Oil Bearing Sandstones—Charles B. Carpenter and George B. Spencer, in BUREAU OF MINES REPORT OF INVESTIGATIONS No. 3540, October, 1940.

There has been some evidence of subsidence of the ground surface over a few producing oilfields which has suggested that the weight of the overlying formations causes a compression and reduction of the volume of the reservoir sand and rocks as oil and gas are withdrawn. This would be analogous to the settling and cracking of the ground resulting from coal mining operations.

To see whether this contraction of oil formations were possible the authors made compression tests on cores of several oil formations. The results showed that for the rocks tested a differential hydrostatic pressure of 8,000 pounds per square inch caused a maximum reduction of 1.084 percent in gross volume and a maximum reduction of 3.608 percent in pore space.

From these results it was deduced that the compressibility of oil-bearing sandstone rocks is not of sufficient magnitude to have an appreciable influence on estimates of reservoir content and ultimate recovery or on fluid and energy relationships of petroleum reservoirs. The maximum pressure applied is equivalent to the normally contemplated differential pressure in wells at a depth of 14,134 feet. As most producing wells do not exceed depths of 8,000 feet, it seems likely that the possible reduction in volume is negligible.

No compressibility tests were made with shales, but it is believed that sedimentary rocks composed of shale should exhibit much higher reduction in volume than sandstones; it is concluded, therefore, that subsidence of the surface over some oilfields results from dehydration and consequent shrinkage of shale beds not from changes in volume occurring within the reservoir itself

A COMPLETE LINE OF

DROP FORGED STEEL VALVES

SERIES 60 - 90 - 150

Ask for Oil Catalogue Nr. 360 and Pamphlet No. 304

DIKKERS

HENGELO-HOLLAND

Valve makers since 1879